INTERNATIONAL RADIO CONSULTATIVE COMMITTEE
(C.C.I.R.)

FIFTH MEETING
STOCKHOLM 1948

RECOMMENDATIONS MADE BY THE COMMITTEE
LIST OF QUESTIONS TO BE STUDIED
LIST OF STUDY GROUPS
OPINIONS EXPRESSED BY THE COMMITTEE

INTERNATIONAL TELECOMMUNICATION UNION
AUGUST 1948

Printed in Sweden

CORRIGENDUM

The following modifications must be made to the Book of Recommendations and Questions of the C. C. I. R.

Page 12 (Recommendation nº 3),
page 22 (Recommendation nº 5), three last paragraphs,
page 50 (Recommendation nº 10),
page 69 (Recommendation nº 18), four last paragraphs,
page 73 (Recommendation nº 19), two last paragraphs,
page 86 (Recommendation nº 24), four last paragraphs,
page 90 (Recommendation nº 25), two last paragraphs.
page 99 (Recommendation nº 28),

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, which were committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they did not accept this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Page 35 (Recommendation nº 6), two last paragraphs,
page 39 (Recommendation nº 7), two last paragraphs,
page 43 (Recommendation nº 8),
page 46 (Recommendation nº 9),
page 53 (Recommendation nº 11), two last paragraphs,
page 56 (Recommendation nº 12), two last paragraphs,
page 57 (Recommendation nº 13), two last paragraphs,
page 59 (Recommendation nº 14),
page 62 (Recommendation nº 16), two last paragraphs
page 63,
page 94 (Recommendation nº 27),
page 104 (Recommendation nº 29), four last paragraphs,

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they wished to reserve their opinion with regard to this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Page 141 (Question n° 11),
page 144 (Question n° 12), two last paragraphs,
page 148 (Question n° 13),

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they did not accept this question :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Page 176 (Question n° 25) :
Delete both paragraphs.

Page 184 (Question n° 27) :
Delete the last four lines.

Page 211 (Opinion n° 2), four last paragraphs,

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they did not accept this opinion :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Page 38 (Recommendation n° 7), last line,

read : *Extreme South, Middle and Extreme North West.*

Page 48 (Recommendation n° 10) :

2nd line of Recommendation should read :

(See Opinion n° 2 and Question n° 13).

The same correction should be made in the last line of paragraph 2.

Page 65 (Recommendation n° 18), after (b),

add :

(c) *that it is desirable that this service should comprise carrier and modulation frequencies with identical values in all transmitters as well as time signals of a uniform type ;*

Page 92 (Recommendation n° 27),

amend (e) to read :

(e) *that the measurements should be extended to disturbances affecting all types of receivers constructed according to modern transmission technique, especially television ;*

and add :

(f) *that Bucharest Recommendation n° 88 should be extended to all disturbances due to causes other than signals produced by transmitters ;*

Page 145 (Question nº 13),

amend footnote to read :

See opinion nº 2.

Page 154 (Question nº 16), after (a),

add :

(b) *that it would nevertheless be desirable for such measurements to be undertaken;*

Page 177 (Question nº 26),

add footnote as follows :

(1) *Co-ordination should take place in the study of this question and that of related questions nº 1 and 25.*

Page 192 (Question nº 28), add at the end of the page :

(Question 21 of Bucharest).

Page 200 (Study Groups of the C. C. I. R.), insert after the title :

(Chapter 12 of the Atlantic City General Regulation, 1947).

INTERNATIONAL RADIO CONSULTATIVE COMMITTEE
(C.C.I.R.)

FIFTH MEETING
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RECOMMENDATION N° 1

Channel Separation

The C.C.I.R.

considering :

(a) that the factors which determine frequency separation between channels in the more usual cases include:

the signal energy intercepted by the receiver,
the interference energy intercepted by the receiver including that from interfering signals and from noise,
the characteristics of the receiver,

(b) that transmitters in general emit radiations lying outside of the frequency band absolutely essential for good communication;

(c) that a large number of factors are also involved, including the properties of the transmission medium, which are variable in character and difficult to determine;

recommends :

1. that the required separation between channels be calculated by the method of:

first finding the signal energy intercepted by the receiver,
then finding the interfering energy intercepted, including both noise and interfering signal,
and from these data determining the degree of

frequency separation that produces acceptable ratios of signal energy to the interfering energy for an acceptable percentage of time for the type of communication desired, taking into account the fluctuating nature both of signal and interference;

2. that at every stage of the calculation, comparison should be made, as far as possible, with data obtained under controlled representative operating conditions, especially in connection with the final figure arrived at for the channel separation.

The study of this recommendation is assigned to Study Group N°3.

RECOMMENDATION N° 2

Noise and Sensitivity of Receivers

The C.C.I.R.

considering :

(a) that the noise level at the output of receivers is a limit to the maximum useable amplification;

(b) that as a result, the sensitivity of receivers for the weakest useable signal is essentially related to the ratio of the level of the signal output to the noise level in the reproduction apparatus;

unanimously recommends :

1. that for the purpose of the present recommendations the following definitions shall apply:

(a) Receiver noise. The receiver noise is the electrical power which appears in the reproduction apparatus associated with the receiver as a result of electronic phenomena and various disturbances in the valves and the other constituent parts of the receiver.

(b) Sensitivity of a receiver. The sensitivity of a receiver is a measure of its ability to receive weak signals and reproduce them with

useable intensity and acceptable quality.

2. that noise and sensitivity of receivers being closely related must be considered together;

3. that this consideration leads to the concept of maximum useable sensitivity, which is measured by the minimum value of the signal which must be applied to the input of the receiver to obtain, at the output, the signal level with signal-to-noise-ratio necessary for normal operation.

In general this sensitivity is determined from a consideration of the level of the signal at the output of the receiver when normal intelligence is being transmitted ("working level") and the level of noise at the output of the receiver in the absence of transmitted intelligence ("rest level");

For instance: in A1 Telegraphy the working level is taken as the key-down condition, and the rest level as the key-up condition.

In telephony the working level is taken as corresponding to a predetermined depth of modulation, and the rest level to the unmodulated condition;

4. that when the receiver is well designed and constructed, noise arises principally in the input stage, and a part of this noise is unavoidable. Consideration

should be given to the "noise factor", i.e. the ratio of the total internal noise to the unavoidable part of the noise;

5. that the study of established methods of measuring noise and sensitivity be continued, so that documents relating to the methods of measurement used by various countries may be interchanged, and that standard methods of measurements, applicable to as many methods of radiocommunication as possible, be recommended.

The study of this Recommendation is assigned to
Study Group No 2

RECOMMENDATION N° 3

Bandwidths of Emissions

The C.C.I.R.

considering :

(a) that the necessary bandwidth can be defined on the basis of three different points of view:

1. the bandwidth strictly necessary for the transmission of the desired information with the required quality;
2. the bandwidth actually occupied by an emission according to the definition in Chap. I, Art. 1, No. 58 of Atlantic City Radio Regulations (1947);
3. the envelope of the complete emitted spectrum which has to be considered for the determination of the interference caused to the neighbouring channels;

(b) that the above three points of view must be considered respectively with the three points listed below:

1. ensuring a communication link under the conditions desired by the two correspondents (that is to say, for example, maintaining the telephonic quality laid down, or the percentage of errors admitted in telegraphy);
2. enabling the operating agencies themselves, the national and international organizations, to carry out measurements of the bandwidth actually occupied by a given emission, and so to ascertain that such an emission does not occupy an excessive bandwidth in view of the service to be carried out (point (a) 1.)

and is therefore not likely to create harmful interference beyond the limits laid down for this class of emission. The use of the definition given in the Regulations is then a useful way of requiring the operating agencies to restrict the amplitude of emitted compounds outside the strictly necessary bandwidth as defined in (a) 1.;

3. enabling the necessary inter-channel separation to be determined.

(c) that these three definitions are not independent, and that since the emitted spectrum can only be completely represented by a curve extending some distance appreciably beyond the assigned frequency, the two other definitions merely represent two pairs of points located on that curve, so giving a first and convenient approximation to the shape of the spectrum envelope;

recommends :

1. that for each service, for each class of emission, it is desirable to specify the envelope curves and the bandwidths defined as in (a) 1., (a) 2., and (a) 3. above, which characterise every class of equipment employed;

2. that the bandwidths (a) 1. and (a) 2. so determined should be quoted together in future drafting of the Radio Regulations [1] and also in documents

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1) In particular, the indication of a limit frequency, whose transmission has to be assured, should always be accompanied by the indication of the maximum attenuation allowable on this frequency.

relating to the frequency assignments and in documents relating to the infractions;

3. that the complete envelope curve should be utilised for the determination of interference and of channel separation;

4. that the following bandwidths for simple telegraphy, amplitude modulation, continuous waves (A1) should be adopted:

(a) Necessary bandwidth. The necessary bandwidth is equal to three times the keying speed in bauds, the level of the components at the edges of the band being not more than 3 db below the level of the corresponding components of the spectrum of a series of equal rectangular dots and spaces of the same keying speed.

This relative level of -3 db corresponds to an absolute level of 22 db below the level of a continuous mark.

(b) Bandwidth occupied. The bandwidth occupied, that is, that containing 99% of the emitted power, is equal to five times the keying speed in bauds, with an attenuation of the components at the edges of the band equal to at least 3 db in comparison with the

level of the same components of the spectrum representing a series of equal rectangular dots and spaces at the same keying speed.

This relative level of -3 db corresponds to an absolute level of 27 db below the level of a continuous mark. 1)

(c) Attenuation of the complete spectrum outside the band occupied. Outside the occupied band defined above, the envelope of the spectrum should lie below a curve starting at the points $(\pm \frac{5B}{2}$, - 27 db) defined above and presenting a slope of 30 db per octave and extending over at least one octave, that is, up to the points ($\pm$ 5B, - 57 db). From these points onwards the level of all the components emitted should be below 57 db. 2)

---

1) The possibility of meeting conditions given in paragraphs (a) and (b) is related to an appropriate build-up time of the signal which is defined as follows:

Build up time of the signal: The time during which the telegraphic current passes from one tenth to nine-tenths (or vice-versa) of the value reached at the steady state.

(In the case of asymmetric signals two different values corresponding to this definition can exist, representing the build-up times at the beginning and end of the signal.)

2) These limitations are recognised as being attainable with existing technique and have actually been met by certain transmitters in service at the time of drafting of the present resolution.

E R R A T A

page 12 Add at the end of Recommendation :

The study of this recommendation is assigned to

Study Group N°1 .

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Bielorussian Soviet Socialist Republic, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Czechoslovakia, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bulgaria (Popular Republic of) Hungary, Roumania (Popular Roumanian Republic).

RECOMMENDATION N° 4

Bandwidth of Receivers

The C.C.I.R.

considering :

(a) that receivers should not be influenced by transmissions occupying frequency bands other than those which are intended to be received;

(b) that the state of technique has evolved to such an extent as to make it possible to approach these ideal conditions;

unanimously recommends :

1. that for the purpose of the study of receiver bandwidth the following definitions be adopted:

(a) Passband. The band of frequencies limited by the two frequencies for which the attenuation differs from the attenuation of the most favoured frequency by some agreed value. In general this value is 6 db, except for high quality radiotelephony receivers where the value is 2 db.

For future applications it may be necessary to consider lesser values.

(b) Attenuation slope. On each side of the band, the ratio:

$$\frac{\text{difference of attenuation obtained for two frequencies beyond the passband}}{\text{difference between these frequencies}}$$

In practice sufficient indication is obtained in considering the difference of frequencies corresponding to the attenuations of 20, 40 and 60 db reckoned from the limit frequencies (Fig. 1). When the values thus obtained are essentially equal for the two sides of the band it is sufficient to give mean values;

2. that the essential bandwidth of a receiver is determined by the width of the spectrum of the signal to be received which will permit the reproduction of the intelligence contained in the signal with the minimum of intelligibility necessary for the service considered;

3. that, in practice the bandwidth is increased beyond the essential band because of the variation with time of the filter characteristics of the circuits, and because of the instability of the frequencies of the received wave and of the frequency

changer oscillators of the receiver;

4. that, in order that the bandwidth of receivers may be reduced as closely as possible to the minimum value, it is necessary,

(a) to improve the stability of the filter characteristics,

(b) to reduce the instability of the frequency changer oscillators,

(c) to reduce the effect of this instability, e.g. by controlling their frequency automatically from the frequency of the received wave;

5. that, since the total bandwidth of a receiver is determined by a series of filters it is necessary to adopt the best compromise to avoid spurious responses and intermodulation products which may arise when subject to intense interfering signals;

6. that, after having provided at the input stages of the receiver the most appropriate filtering, use shall be made, whenever possible, in the intermediate frequency circuits, of special filters such as crystal filters, which provide an important increase of the attenuation slope and a better protection against interference;

7. that the study of receiver characteristics shall continue, and that, for this purpose, the study group should collect all necessary information about the receivers in use in the different countries.

For information an annex is attached giving some values of bandwidth and attenuation slopes taken from a few receivers intended for different services.

ANNEX

Bandwidths and attenuation slopes of various radio receivers.

Service	Bandwidth (kc/s)	Attenuation slope (db/kc/s)	Type of communication	Reference
fixed	1	40	telegraph	1
	2.6	45	telegraph	1
	8	30	telephone	1
	12.3	22	telephone	1
	1.3	45	telegraph	2
	4.9	16	telephone	2
	8.1	10	telephone	2
	0.7	50	telegraph	3
	2	34	telegraph	3
	4.5	24	telegraph	3
	2.5	100	telephone reduced carrier	4
	6	120	telephone reduced carrier	5
	0.96	28	telegraph	11
	1	26	telegraph	12
mobile	7	6	ship, A1 A3	6
	2.2	12	ship, A1	7
	10.4	10	ship, A3	7
	8.8	3.6	small boat telephone	8
general purpose receivers	2.5	12	telegraph	9
	7.5	12	telephone	9
	13.5	11	telephone	9
	2.8	10	telegraph	10
	6.4	10	telephone	10

For information and to facilitate the exchange of information the names of the manufacturers and the types of receivers are given, to which reference is made in the last column of the table.

1 = Type V - 1156. R.C.A. Communications Inc.
2 ="Marine" Type, Société Indépendante de T.S.F.
3 ="RECRO" Type, Société Française Radioélectrique with filter of bandwidth 0,7 kc/s.
4 = Single Sideband Receiver of the Netherlands Administration.
5 = Single Sideband Receiver - Société Françaice Radioélectrique.
6 = Type AR8506B. Radiomarine Corporation.
7 = Type C.R.M.12 - Compagnie Radio Maritime.
8 = "Naviphone" Type - Société Française Radioélectrique.
9 = Type AR88, Radio Corporation of America.
10 = Type R.U.95 - Société Française Radioélectrique.
11 = Telegraph Receiver for A1 and F1 of the Netherlands Administration.
12 = Type RT4 - Le Matériel Téléphonique.

The study included in this Recommendation is assigned to

Study Group No 2

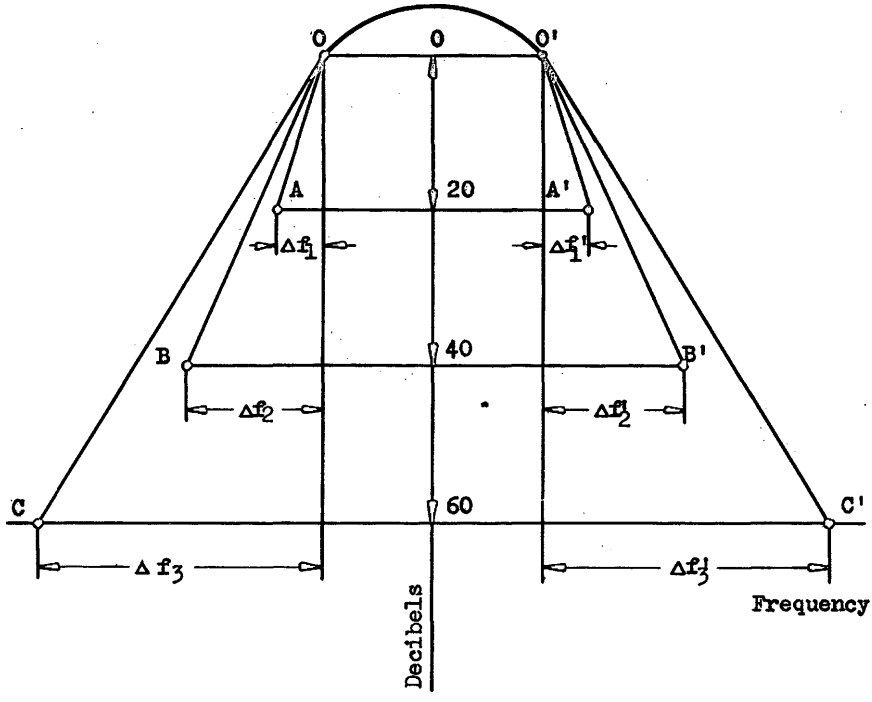

Fig. 1

Legend:

00'	Pass band
$\Delta f_1, \Delta f_1'$	Frequency difference corresponding to 20 db attenuation
$\Delta f_2, \Delta f_2'$	Frequency difference corresponding to 40 db attenuation
$\Delta f_3, \Delta f_3'$	Frequency difference corresponding to 60 db attenuation

The points O,A,B,C and O', A', B', C', are located on the selectivity curve of the receiver.

RECOMMENDATION N° 5.

The Measurement of Atmospheric Radio Noise by the Existing Methods.

The C.C.I.R.,

considering :

(a) that it is necessary to establish precise methods for the measurement of atmospheric radio noise;

(b) that such studies require a considerable period of time, during which the operational requirements of operational radio communication make it necessary to continue gathering empirical information;

(c) that the only method now generally available is the method of the British National Physical Laboratory (Thomas method);

(d) that this method can be improved, without great difficulty;

(e) that it is, nevertheless, desirable to await the establishment of more accurate methods before considering further world-wide plans for systematic measurements;

recommends :

1. that the subjective method now employed for the measurement of atmospheric radio noise (subjective Thomas method) should undergo the following improvements:

a) the use of a better wave collector,

comprising

1. one or several antennas longer than those presently employed, in order to increase the atmospheric radio noise pick up;
2. an effective ground system for the reduction of losses and possible antenna resonance effects;

b) Installation of a pre-amplifier similar to the one described in report CRPL-5-1 of the Central Radio Propagation Laboratory of the U.S. National Bureau of Standards. This apparatus has the purpose of increasing the atmospheric radio noise input to the receiver relative to the internal noise of the receiver itself;

c) Calibration of the apparatus by means of a pulsed test transmitter, rather than the presently employed continuous-wave transmitter, in order to reduce calibration errors due to transient effects;

d) The experimental use of a recording meter, for example of the Esterline Angus type, at certain sites where the noise level is high. A recording device will permit a

partly objective method of measurement;

2. that measurements with equipment embodying these improvements should be carried out as practicable at existing installations;

3. that the results of measurements should continue to be centralized by the National Physical Laboratory of the United Kingdom;

4. that the Sixth Study Group coordinate this work.

The study of this Recommendation is assigned to Study Group No.6.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General regulations, the People's Federal Republic of Yugoslavia declared that it wished to reserve its opinion with regard to this recommendation.

RECOMMENDATION No 6

Standardization of Symbols and Presentation of Results of Ionospheric Soundings

The C.C.I.R.

considering :

(a) that the International Telecommunications Conference (Atlantic City,1947) requested the C.C.I.R. to study the "standardization of symbols and the presentation of the results of ionosphere sounding and, if appropriate, of certain methods of measurement, in order to ensure that measurements from different sources may be directly comparable;"

(b) that, although some standardization has been achieved in observing and reporting ionospheric data, the data are still insufficiently homogeneous in many respects to permit the comprehensive statistical analysis required for the best delineation of radio propagation conditions on a word-wide basis;

(c) that, because of wide variations between ionospheric characteristics in different parts of the world, ionospheric sounding equipment developed for operation in a particular region has at times proved inadequate for operation at stations located in other regions;

(d) that observations of ionospheric characteristics are subject to limitations imposed by the nature of the ionosphere itself and by the characteristics of observing equipment (resolution, radiated power, frequency and height ranges, etc.);

(e) that diverse practices exist with regard to duration of observations and times at which observations are made, which lead to needless complications in general use of ionospheric data;

(f) that a certain minimum number of types of ionospheric data are necessary for the representation of ionospheric characteristics on a world-wide basis, and their application to the needs of high frequency telecommunication ;

recommends :

1. that use of the symbols detailed below be recognized in the interchange of ionospheric data:

(a) General symbols (See Annex 1).

(b) Symbols representing numerical values of characteristics most commonly observed or derived from ionospheric records (See Annex 2).

(c) Qualifying symbols (See Annex 3).

(d) Descriptive symbols (See Annex 4).

2. that, recognizing that some of the symbols may not be entirely acceptable in their present form, Administrations be invited to submit what are considered improved symbols and definitions for consideration by the next meeting of the C.C.I.R.

3. that ionospheric observations should be made at least once an hour, on the hour, using local mean time corresponding to the nearest or most convenient meridian of longitude from Greenwich which is an integral multiple of 15°; this meridian to be clearly specified when reporting the data. In submitting results of observations

in regular bulletins or on regular exchange forms, each national organization charged with such exchanges should state clearly the times of observation in U.T. (G.M.T.) as well as the local mean time as above.

4. that the interchange of ionospheric characteristics should include either

(a) Tabulation of hourly observations by days for each month, or

(b) Monthly median values for each hour, including if possible the median count,

or both. See Annex 5 for definitions of median values and median counts, and for conventions for determination of median values of ionospheric characteristics.

5. that equipment for ionospheric sounding should preferably meet at least the following requirements :

(a) Peak power output : 1 kW

(b) Frequency range : 1 Mc/s to 20 Mc/s

(c) Height range over which measurements are possible : 50 to 1000 km

(d) Accuracy of calibration : 10 Km in height 0.1 Mc/s in frequency

(e) Length of pulse : 100 microseconds or less

(f) Length of time for each observation :

(1) automatic : 2 minutes or less

(2) manual : 15 minutes or less

6. that at least data for foE, foF1, foF2, and (M3000) F2 (See Annex 2) be interchanged, and that in addition, when possible, data for fEs, h'E, h'F1, h'F2, and hpF2 (Annex 2) also be interchanged.

ANNEX 1

General Symbols

1.	f	frequency
2.	fo	ordinary-wave critical frequency
3.	fx	extraordinary-wave critical frequency
4.	fz	critical frequency corresponding to the lowest-frequency branch of triply split h'f curve
5.	h'	virtual height (frequently used to denote minimum virtual height)
6.	hp	virtual height measured on ordinary-wave branch at a frequency equal to 0.834 times fo
7.	MUF	maximum usable frequency
8.	d-MUF	maximum usable frequency for a path of some specified standard length d
9.	FOT	optimum traffic frequency (formerly optimum working frequency)
10.	LUF	lowest useful high frequency
11.	Md	maximum usable frequency frequency factor for a path of some specified standard length d
12.	h'f	an observation displaying the virtual height h' as a function of frequency f
13.	h't	an observation displaying the virtual height h' as a function of time t for a specified fixed frequency

Note: It is now very nearly universal practice to specify quantities in the above list representing frequencies in megacycles per second, and to specify quantities representing height or distance in kilometers. Exceptions should always be clearly indicated, as for example the use of miles in symbols 8 and 11.

In the table above the abbreviations MUF, FOT, and LUF should be left unaltered in sequence of letters when translated into various languages in order to preserve them as pronounceable words.

ANNEX 2

Symbols Representing Numerical Values of Characteristics Most Commonly Observed or Derived from Ionospheric Records

1.	foE	critical frequency for E-layer ordinary-wave (See Remark 1)
2.	foF1	critical frequency for F1-layer ordinary-wave
3.	foF2	critical frequency for F2-layer ordinary-wave
4.	fxE	critical frequency for E-layer extraordinary-wave
5.	fxF1	critical frequency for F1-layer extraordinary-wave
6.	fxF2	critical frequency for F2-layer extraordinary-wave
7.	fzF1	critical frequency for F1 layer corresponding to the lowest-frequency branch of an h'f curve showing triple splitting in the F1 layer
8.	fzF2	critical frequency for F2 layer corresponding to the lowest-frequency branch of an h'f curve showing triple splitting in the F2 layer
9.	fEs	highest frequency on which echoes of the sporadic type are observed from the E layer (See Remark 2)
10.	fbEs	the lowest frequency at which echoes from the F layer are observed when the sporadic echoes from the E layer are of the intense or blanketing type
11.	h'E	minimum virtual height of E layer on ordinary-wave branch
12.	h'F1	minimum virtual height of F1 layer on ordinary-wave branch
13.	h'F2	minimum virtual height of F2 layer on ordinary-wave branch
14.	h'Es	minimum virtual height of sporadic echoes from the E layer
15.	hpF1	virtual height of F1 layer measured on the ordinary-wave branch at a frequency equal to 0.834 times foF1
16.	hpF2	virtual height of F2 layer measured on the ordinary-wave branch at a frequency equal to 0.834 times foF2
17.	E-d-MUF	maximum usable frequency for E-layer transmission for path of some specified standard length d

18.	F1-d-MUF	maximum usable frequency for F1-layer transmission for path of some specified standard length d
19.	F2-d-MUF	maximum usable frequency for F2-layer transmission for a path of some specified standard length d
20.	(Md) E	maximum usable frequency factor for E-layer transmission for a path of some specified standard length d
21.	(Md) F1	maximum usable frequency factor for F1-layer transmission for a path of some specified standard length d
22.	(Md) F2	maximum usable frequency factor for F2-layer transmission for a path of some specified standard length d

Remark 1: In the event that clear stratification is evident within the regular E layer, and a second critical frequency is observed, it is the increasingly common practice to refer to the upper critical frequencies as foE2 and fxE2, and the minimum virtual height as h'E2.

Remark 2: Understanding of the processes which give rise to sporadic E reflections is still largely lacking. There have been cases reported in which sufficient retardation, and also change in echo intensity, has been observed to suggest the possibility of using such symbols as foEs, and fxEs. When this resolution is not possible, it is customary to regard fEs as equivalent to foEs.

Note: It is now very nearly universal practice to specify quantities in the above list representing frequencies in megacycles per second, and to specify quantities representing height or distance in kilometers. Exceptions should always be clearly indicated, as for example the use of miles in symbols 17 to 22 inclusive.

It should be remarked that all symbols of the above list are to be typeset as typewritten, on a straight line, i.e. superscripts and subscripts are no longer to be used.

ANNEX 3

Qualifying Symbols

1. ( ) Individual observed values thus enclosed are considered doubtful. The reason for doubt should be specified by an appropriate descriptive symbol (See Annex 4) or by a footnote.

2. [ ] Individual numerical values thus enclosed represent interpolations rather than observations. The reason for the interpolation should be specified by an appropriate descriptive symbol (See Annex 4) or by a footnote.

Note Concerning Interpolation:

In hourly tabulations of ionospheric characteristics it is considered desirable to replace a single missing value by an interpolated value. If, however, two or more consecutive hourly values are missing, interpolation should not be performed. The matter of interpolation is given further attention in Annex 4.

ANNEX 4

Descriptive Symbols

	Symbol	Notes on Use Which Refer 1)	Definition
1.	A or a	2, 5, 6	characteristic not measurable because of blanketing by Es
2.	B or b	2, 5, 6	characteristic not measurable because of absorption either partial or complete
3.	C or c	1, 5	characteristic not observed because of equipment failure
4.	D or d	1, 4	characteristic at a frequency higher than upper frequency limit of equipment
5.	E or e	1, 4	characteristic at a frequency lower than lower frequency limit of equipment

1) See page 32.

	Symbol	Notes on Use Which Refer	Definition
6.	F or f	2, 5, 6	spread echoes present
7.	G or g	1, 4	a) F2-layer critical frequency equal to or less than F1-layer critical frequency b) no sporadic E echoes observed
8.	H or h	3, 6	stratification observed within the layer
9.	J or j	3, 6	ordinary-wave characteristic deduced from measured extra-ordinary-wave characteristic
10.	K or k	3, 6	ionosphere storm in progress
11.	L or l	1, 5, 6	a) critical frequency, MUF, or MUF factor for F1 layer omitted because no definite or abrupt change in slope of the h'f curve is observed either for the first reflection or for any of the multiples b) minimum virtual height for F2-layer omitted because the F2-layer trace is continuous with the F1-layer trace, but without a point of zero slope.
12.	M or m	1, 5	characteristic not observed because of some failure or omission on the part of the operator, rather than owing to any mechanical or electrical fault in the equipment or its power supply
13.	N or n	1, 5, 6	unable to make logical interpretation
14.	P or p	3, 6	trace extrapolated to critical frequency
15.	Q or q	1	distinct layer not present
16.	R or r	2, 5, 6	curve becomes incoherent near F2-layer critical frequency
17.	S or s	2, 5, 6	characteristic obscured by interference

	Symbol	Notes on Use Which Refer	
18.	T or t	1, 5	loss or destruction of successful observations
19.	V or v	3, 6	trace forked near critical frequency
20.	W or w	1, 4	characteristic at a height greater than the upper height limit of equipment
21.	Y or y	3	Es trace intermittent in frequency range
22.	Z or z	3	three components of h'f curve of layer observed

General Notes:

For nearly all purposes enough symbols have been provided to make it unnecessary to leave any blank spaces in monthly tabulations of hourly values. In the event that no symbol should be found to be entirely satisfactory a suitable footnote should be given. Blank spaces in the tabulation sheets will be taken to indicate that no observation was scheduled at the given hour.

It should be noted that many occasions will arise when more than one letter symbol is appropriate to describe circumstances of a particular observation. There should be no hesitation at recording several descriptive symbols, if appropriate, in elucidating the circumstances surrounding a particular observation. In some cases it will be found that one letter symbol can well be used to describe or qualify another.

In use of the above letter symbols, capital or block letters are to be preferred on the grounds that small script letters are sometimes illegible or misleading, because of their resemblance to numbers. The capital or block letters are preferable in script.

Notes on the Use of the Descriptive Symbols:

1. The following descriptive symbols are used only in place of an observed numerical value:

   C, D, E, G, L, M, N, Q, T, and W

2. The following descriptive symbols may be used either in place of, or to qualify an observed numerical value:

A, B, F, R and S

3. The following descriptive symbols may be used only to qualify an observed numerical value:

H, J, K, V, Y, and Z

4. Certain of the descriptive symbols when used in place of an observed numerical value, have the same force as an actual number when medians are taken, and should therefore be included in the median count in the manner made appropriate by their definitions. It should be noted, however, that if half or more of the observations are represented by these symbols, the median can only be indicated as greater than or less than the numerical value of the limitation represented. These symbols are:

D, E, G, and W

5. When an observed numerical value has been replaced with certain of the descriptive symbols, it is frequently permissible to enter an interpolated value (See discussion of interpolation practice in Annex 3). Such symbols, which then qualify the interpolated value, are:

A, B, C, F, L, M, N, R, S, and T

6. When an observed numerical value is indicated as doubtful by the use of parentheses, the reason for doubt should always be indicated. The following descriptive symbols are often used to provide the explanation:

A, B, F, H, J, K, L, N, P, R, S, and V

ANNEX 5

Median Values, Median Counts, Conventions for Determination of Median Values of Ionospheric Characteristics

1. Definitions

(a) For a set consisting of an odd number of numerical values, the median value is the middle value of the set when its members are arranged in order of size.

(b) For a set consisting of an even number of numerical values, the median value is the arithmetic mean of the two middle values of the set when its members are arranged in order of size.

(c) For a set of numerical values, the median count is the number of numerical values in the set.

2. Conventions

(a) Rounding off A median value found according to "b" above, should contain no more significant places than an individual member of the set. Therefore, rounding off, for example to the nearest even digit, in the last place may at times be necessary.

(b) Use of Certain Descriptive Letter Symbols as Numerical Values for Purposes of Finding a Median Value. This matter is discussed in Annex 4 under note 4 on the usage of the descriptive symbols. The letter symbols which have the force of numerical values are: D, E, G, and W.

(c) Doubtful Monthly Median Values. Such values for a characteristic observed at a specified hour are indicated, as in the case of doubtful single values, by inclusion in parentheses. See Annex 3. The following conventions may be used to determine whether or not a median value is doubtful:

1. If only four values or less are available, the data are considered insufficient and no median value is determined. The monthly summary should in such cases show a dash.

2. For the F2 layer, if only five to nine values are available, the median is considered doubtful. The E and F1 layers are so regular in their characteristics that, as long as there are at least five values, the median is not considered doubtful.

3. For all layers, if more than half of the numerical values used to compute the median are doubtful (either doubtful or interpolated), the median is considered doubtful.

The study included in this Recommendation is assigned to Study Group No 6.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Poland, Ukrainian Soviet Socialist Republic, Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION N° 7

Location of Ionospheric Stations

The C.C.I.R.

considering :

(a) that the International Telecommunication Conference (Atlantic City, 1947) requested the C.C.I.R. to study the "suitability of the geographical locations of existing ionospheric sounding and other observation stations and requirements for future observations at new stations";

(b) that the existing network is inadequate to provide sufficient understanding of world-wide radio communication phenomena or permit full delineation of the characteristics of the ionosphere;

(c) that insofar as possible, the locations of new ionospheric stations should be chosen so as to be of greatest usefulness for the scientific study of the ionosphere, for the operational use of the data for radio propagation predictions, studies, and for a posteriori analysis;

(d) that it is desirable, for greatest usefulness, for ionospheric sounding stations to be located with particular regard to:

1. Delineating the features of the ionosphere in the critical regions around the magnetic equator and the auroral zones;
2. Obtaining data in the regions of the world which now have few or no ionospheric stations;
3. Obtaining data suitable for either
   a) an adequate extension of the present zonal system of representing ionospheric

characteristics based upon geomagnetic coordinates, or

b) an adequate basis for constructing world ionospheric charts for a series of specified intervals of the day stated in universal time (U.T.);

or both,

4. Taking advantage of facilities which may exist or may be anticipated for operation of ionospheric stations.

5. Facilitating the scientific researches organised by U.R.S.I. intended to advance the knowledge of the ionosphere and to perfect the methods of ionospheric predictions;

recommends:

1. that the following general principles govern the location and distribution of new ionospheric stations:

(a) Stations should be located, where practicable, along or near great circle paths corresponding to principal communication routes, or in the regions crossed by the greatest number of important communication routes.

(b) Stations should be spaced most closely together in the neighbourhood of the geographic and magnetic equators, where

special effects, as yet imperfectly understood, are known to occur and where large changes in the distribution of ionization are known to take place with comparatively small changes of latitude;

2. that the administrations take what steps are practicable to locate new ionospheric observing stations where there are at present the greatest needs for new stations, that is:

(a) South America:

Colombia
Venezuela
Ecuador
Brazil (more than one new station)
Argentina (more than one new station)
Chile (more than one new station)

(b) Africa:

North Africa and Sahara
Egypt
West Africa
Equatorial Africa including East Africa
Madagascar and neighbouring islands
South Africa

(c) Central America:

(d) North America:

Mexico
Northeastern Alaska or Northwestern Canada

(e) Greenland:

Extreme South, Middle and Extreme

(f) Iceland:

(g) Europe:

Mediterranean Area, Italy (Sicily)
Norway
Sweden

(h) New Guinea and Bismarck Archipelago (more than one new station)

(i) Indo-China)
Malaya) several stations
Netherlands East Indies)

(j) Philippine Islands: Extreme north and extreme south

(k) Middle Pacific:

Marquesas
Pitcairn

(l) Asia:

Tibet)
U.S.S.R.) several stations

(m) Antarctica (more than one station)

(n) Middle Southern Atlantic (meteorological vesse

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION N° 8

Study of Absorption in the Ionosphere

The C.C.I.R.

considering :

that a detailed knowledge of the magnitude of the absorption of radio waves being transmitted through the ionosphere is necessary for the practical design and engineering of radio broadcasting and communication circuits and services;

recommends :

1. that the subject of the absorption of radio waves in the ionosphere be studied by all national administrations in the light of the information on the subject given in Documents of the fifth Meeting of C.C.I.R. nos. 8 and 23 from the United Kingdom and United States of America respectively;

2. that arrangements be made where practicable for absorption measurements at vertical incidence to be carried out at existing and future ionospheric recording stations;

3. that until a better understanding of the subject is obtained, the results of such measurements be circulated in regular bulletins together with

those of other ionospheric measurements, in the form and using the nomenclature described in the Annex;

4. that all administrations who are or will be in the future in a position to do so, should use systematic field strength recording of the signals from selected sending stations, for the study of the absorption of waves being transmitted to various distances through the ionosphere.

It is suggested that administrations undertaking this type of study should collaborate with one another in the drawing up of schedules of observations, and in the analysis of the results obtained.

ANNEX

There are apparently very few organisations at present making regular measurements of absorption in the ionosphere. It is suggested that arrangements should be made for absorption to be measured at vertical incidence at the existing sounding stations, and the results circulated with those of other ionospheric measurements.

Although regular bulletins of absorption data at vertical incidence are now being issued from the United Kingdom it is recognised that it is necessary to exercise caution in the application of the data to practical problems of radio communication. The formula which is used at present to represent the absorption at normal incidence is

$$\log_e \rho = \frac{K}{(f \pm f_L)2} \cos^n \chi$$

where ρ is the reflection coefficient of the ionized region

f is the wave frequency

f_L is the gyro-frequency corresponding to the component of the earth's magnetic field along the ray path

χ is the zenith angle of the sun, at the place and time of observation

K is an absorption index that varies with the general state of the ionosphere

The index n depends in a complicated manner upon the values of f and χ and on other factors such as sunspot cycle, season etc. and, in general, has a value between 1 and 1.5.

The positive and negative signs refer to the ordinary and extraordinary rays respectively.

As the above formula is known to be not always valid, an alternative expression of an empirical nature may be found more satisfactory in some cases. It is recommended that the whole subject should be given further study both from a theoretical and an experimental aspect.

The studies included in this Recommendation are assigned to Study Group No 6

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Ukrainian Soviet Socialist Republic,
People's Federal Republic of Yugoslavia.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION No. 9

Concerning the Study of

Pulse Transmissions at Oblique Incidence

The C.C.I.R.

considering :

that there are many aspects of ionospheric propagation of great importance to the communications engineer that can very usefully be studied by the use of pulse technique; for example,

(a) the relation of oblique to vertical incidence transmissions with regard to the maximum useable frequency and more especially with regard to absorption;

(b) the relation of the propagation characteristics to the direction of the earth's magnetic field;

(c) the validity of the control point method for determining the maximum useable frequency for very long routes;

(d) the nature of lateral deviation and its dependence on diurnal and seasonal changes in the ionosphere and on the direction of the earth's magnetic field;

(e) the characteristics of signals received by scattering from sources off the great circle path;

(f) the properties of abnormal or sporadic E reflections, especially in the auroral regions;

(g) the nature of the transition from the multiple reflection type of transmission at short distances to the complex type of reception obtained where pulse emissions are received at long distances;

recommends:

1. that the transmissions of pulses on fixed frequencies should be encouraged wherever practicable and that an international organisation be set up whereby those wishing to make observations on such transmissions may be kept informed of their time schedules, so that they may use them for the study of radio wave propagation through the ionosphere under various oblique incidence conditions;

2. that such transmissions may be provided by:

(a) fixed service transmitters at times when they are not required for traffic;

(b) broadcasting transmitters when not required for programmes;

(c) transmitters operated by research organisations or installed at ionospheric sounding stations.

The study included in this Recommendation is assigned to Study Group No 6

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION No. 10

General Recommendation Relating to Study of Atmospheric Radio Noise

The C.C.I.R.

considering :

(a) that atmospheric radio noise imposes one of the important limitations on radio operations;

(b) that therefore the necessity for world-wide measurements of natural radio noise, and the measurement of its effects on the operation of radio equipment is evident;

(c) that there is now little information on what characteristics of radio noise are most important from the point of view of operation of different types of service;

(d) that no single characteristic of radio noise (e.g. r.m.s. value of noise, average peak noise, etc.) is sufficient to describe the effects of noise on radio equipment;

(e) that aside from noise originating in desert sandstorms, precipitation, static electricity in aircraft, etc., the primary source of natural radio noise at frequencies below 30 Mc/s lies in electrical discharges in thunderstorms;

(f) that electrical noise from thunderstorms is propagated to a receiver as impulses and therefore it is the response of the wave-collector and receiving system to these impulses that needs to be studied;

(g) that atmospheric radio noise has wide variations from day to day, hour to hour, and minute to minute;

(h) that measurements of radio noise may be made by either objective methods (automatic recording), or subjective methods (estimations of required field intensity), or by a combination of the two (semi-automatic recording involving manual monitoring);

recommends :

1. that meteorological studies should be undertaken (See Opinion No. 3 and Question No. 13) to provide knowledge of the distribution of thunderstorm electrical discharges per unit surface area, throughout the world;

2. that these meteorological observations of thunderstorms by visual or aural means should be supplemented by standardized electrical means of recording (See Opinion No. 3 and Question No. 13);

3. that studies should be undertaken to determine comparative characteristics of the atmospheric noise output of a receiver for different types of wave-collectors and receiving equipment, for the same atmospheric noise fields (See Question No. 11);

4. that methods of studying the wave forms of arriving radio noise fields, and impulse forms, should be devised (See Question No. 11);

5. that the technique of measuring the direction (in both vertical and horizontal planes) of arrival of

radio noise should be studied and improved with a view to locating the source of noise as accurately as possible (See Opinion No. 2 and Question No. 12);

6. that improvements in sensitivity should be made on the existing Thomas noise-measuring equipment and that methods for automatic recording of desired noise characteristics should be improved (Recommendation No. 5);

7. that first attention should be given to measurements of noise characteristics and effects on receiving equipment in the frequency range 10 kc/s to 30 Mc/s, with particular attention to the range 10 kc/s to 300 kc/s (See Questions No. 11 & No. 12);

8. that studies of the time and frequency distribution of precipitation and other static electrical noise, cosmic, solar and other extra-terrestrial noise, should also be pursued;

9. that separate studies should also be made of man-made noise.

The study included in this Recommendation is assigned to Study Group No 6

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Czechoslovakia, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Poland, Ukrainian Soviet Socialist Republic, People's Federal Republic of Yugoslavia.

RECOMMENDATION N° 11

Best Practical Means for a Rapid Exchange of Information on Propagation

The C.C.I.R.

considering :

(a) that Question 5 of Atlantic City Recommendation No. 1 reads: "Determination of the best practical means for a rapid exchange, on an international basis, of information of all kinds relating to propagation";

(b) that there exist, relative to the exchange and dissemination of propagation information, three categories of users: those who are engaged in making predictions, those who make operational use of propagation information, and those who require the information for scientific research or other purposes. The first two require a means of rapid exchange and dissemination of data, whereas the latter type of user is largely satisfied by the present system of publication by certain central authorities. The existing system of direct exchange between national laboratories engaged in making and analyzing measurements is reasonably satisfactory;

recommends :

that in the interest of simplifying and making uniform the present system of dissemination and exchanges; and to facilitate any further extension thereof.

1. that, each country participating in radio propagation research designate an official agency for the reception, coordination, liaison and exchange of such data with corresponding agencies in other countries;

2. that data necessary for making short term forecasts be exchanged by electrical means; airmail service as available be used for transmission of data of less immediate value;

3. that short, but regular broadcasts as are deemed advisable be made embodying simple short-term propagation forecasts. In addition, these broadcasts could, as seems worthwhile, make available limited quantities of observational material;

4. that the members who make these communications through telegraphic channels should study and test synoptic codes which would permit the summarization of the essential data needed for short term forecasts, and could permit the transmission of warnings of ionospheric disturbances. The results of these tests could form the subject of

a draft recommendation submitted to the sixth meeting of the C.C.I.R.

The Studies included in this Recommendation are assigned to Study Groups Nos 4, 5 and 6.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION N° 12

Best Practical Means for the Publication of Results of Scientific and Technical Investigations on Radio Propagation

The C.C.I.R.

considering :

that question 6 of Atlantic City Recommendation No. 1 reads: "Determination of the best practical means for the publication of scientific and technical investigations submitted by participating administrations and, in addition periodical publication of results such as propagation forecasts having immediate application to radio services.";

recommends :

1. that the best practical method of publication of investigations is by direct exchange between organizations concerned with radiopropagation, or if the subject is of more general interest, by publication in the technical press;

2. that the agency officially designated by a country in connection with the rapid exchange on an international basis of information of all kinds relating to propagation (See Recommendation No. 11) might well be responsible for the exchange of its own

publications with other similar agencies currently maintained lists or catalogues of publications prepared by individuals, groups, laboratories, etc, within its own country, or under its sponsorship;

3. that these lists should include the address from which each publication is available;

4. that a careful study should be made of the matter of preparing and issuing charts of predictions of ionospheric characteristics and the associated wave propagation conditions in a standard form and with a uniform scale. The standard form would be subject to revision as the availability of improved data permits;

5. that a desirable uniform scale would utilize a centimeter grid on which one centimeter would represent ten degrees of latitude and fifteen degrees of longitude or one hour of time;

6. that noting present day currency restrictions, the exchanges above should be, insofar as possible, at no cost to the recipients at least between the officially designated agencies (See 2 above), and at least to the extent of a single copy of a publication or forecast.

The studies included in this Recommendation are assigned to Study Groups Nos 4, 5 and 6.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION N° 13

Concerning Warnings of Ionospheric Storms

The C.C.I.R.

considering :

The importance of giving to operating services and administrations a reliable warning, as far in advance as possible, of the onset of storms or other major disturbances to ionospheric transmission conditions, so that they may arrange their traffic schedules accordingly;

recommends :

that all organisations responsible for issuing forecasts of ionospheric transmission conditions, should study the technique of obtaining warnings of disturbed conditions and the manner in which such warnings should be issued to give as reliable information as possible to the practical user.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION No 14

Review of Publications on Propagation

The C.C.I.R.

considering :

that Question 7 of Atlantic City Recommendation No. 1 reads:

"Review of the value and importance of various phases of propagation work and of publications relating thereto, and the publication of regular recommendations accordingly;"

recommends :

that each country arrange to have a review of its work on radio propagation made, that these reviews be sent to Study Groups No. 4,5 and 6 not later than July 1949, for coordination and issuance, and that those Study Groups submit any conclusions they may reach regarding desirable future work to the next meeting of the C.C.I.R.

The studies included in this Recommendation are assigned to Study Groups Nos 4, 5 and 6.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics

RECOMMENDATION No. 15

Concerning the Question of Tropospheric Wave Propagation

The C.C.I.R.

considering :

(a) that there exists widespread, successful, practical application of radio waves on frequencies above 30 Mc/s, which has taken place since the 1937 Meeting of the C.C.I.R. in Bucharest;

(b) that the propagation of such waves is already known to be greatly influenced by the meteorological conditions in the troposphere;

unanimously recommends :

1. that every possible encouragement be given to the appropriate international scientific radio and meteorological organisations to study the characteristics of the troposphere in all parts of the world and their effect on radio wave propagation;

2. that the technique of measuring the vertical and horizontal gradients of temperature and humidity in the troposphere be studied with special reference to obtaining a more detailed and accurate knowledge of such gradients, and their variation with time and location;

3. that simultaneous studies of radio wave propagation and the associated meteorological conditions be undertaken on as wide a basis as possible;

4. that steps be taken to devise a suitable standard nomenclature for this subject, together with the adoption of a uniform method of presenting both the radio and meteorological results. Such presentation might include the preparation of a uniform of chart indicating the areas of sub-standard, standard and super refracting conditions.

The study included in this Recommendation is assigned to

Study Group No 5

RECOMMENDATION N° 16

Concerning the Comparison of Ionospheric Transmission Forecasts with Practical Results

The C.C.I.R.

considering :

that it is of the greatest importance to the radio communication services (navigation and other services) using waves transmitted through the ionosphere, to have forecasts of such ionospheric transmission conditions of the greatest possible accuracy;

recommends :

that all organisations responsible for studying the characteristics of the ionosphere and making forecasts based on the results of such study should collaborate with operating administrations and others in order to assess from time to time the accuracy of the forecasts made both by themselves and others.

Referring to Chapter 13, Paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation :

Albania (Popular Republic of), Bulgaria (Popular Republic of).

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Bielorussian Soviet Socialist Republic, Hungary, Roumania (Popular Roumanian Republic), Union of Soviet Socialist Republics.

RECOMMENDATION No. 17

Directivity of Antennas at great Distances

The C.C.I.R.

unanimously recommends :

that administrations and organizations suitably equipped carry out experiments on the directivity of antennas at great distances, by the use of directive antennas which can be rotated, or by other appropriate methods.

The study included in this Recommendation is assigned to Study Groups Nos 3, 4 and 6.

RECOMMENDATION N° 18

Standard Frequency Transmissions and Time Signals

The C.C.I.R.

considering :

(a) that the International Administrative Radio Conference, Atlantic City 1947, allocated frequency bands 2.5 Mc/s ± 5 kc/s (2.5 Mc/s ± 2 kc/s in Region 1), 5 Mc/s ± 5 kc/s, 10 Mc/s ± 5 kc/s, 15 Mc/s ± 10 kc/s, 20 Mc/s ± 10 kc/s, and 25 Mc/s ± 10 kc/s, and that the Conference requested the C.C.I.R. to study the question of the provision and operation of a world-wide standard frequency and time service;

(b) that this service should permit measurement with the maximum accuracy and certainty, while using simple receiving equipment;

(d) that the relative merits of several possible programmes of modulation can only be determined by experiment;

(e) that a number of stations will be necessary to provide a world-wide service, and that their simultaneous operation may cause harmful interference, the extent of which can only be determined, and solutions found, by experiment;

(f) that the use of more stations than are technically necessary to provide world-wide coverage would, by producing harmful interference, diminish the utility of the service;

(g) that any experiments that may be made should be so designed and controlled as to minimize disturbance of the existing service;

(h) that the standardisation of time is the responsibility

of the International Committee of Time;

(i) that emissions from standard frequency stations are valuable in studies of radio propagation;

(j) that the periodical broadcasting of information regarding propagation conditions is useful to operators of radiocommunications services;

(k) that it is desirable to improve the facilities for radio noise measurement;

(l) that there is an urgent need to put into operation additional standard frequency and time stations, perhaps in the United Kingdom and in Australia, to serve the now inadequately served areas of the world;

(m) that conclusions should be reached as to the form of the service and the optimum number of stations before the next C.C.I.R. Meeting;

recommends :

1. that experimental emissions on 2.5 - 5 - 10 - 15 - 20 and 25 Mc/s be arranged, particularly to serve the now inadequately served areas of the world, (perhaps from additional stations in the United Kingdom and in Australia, and such other stations as the Study Group No. 7 may find practical and available), to determine the effective service areas and the zones of interference with the existing emissions from WWV;

2. that the Study Group No. 7 organise and control

the experiments, arrange such further experiments as may seem desirable, and report through the Director of the C.C.I.R. to the administrations concerned;

3. that the Study Group No. 7 give the maximum possible consideration, within practicable limits, to the proposals of the administrations which wish to cooperate in the establishment of this service;

4. that the initial experiments be with emissions on 2.5 and 5 Mc/s, to be followed by experiments on 20 and 25 Mc/s;

5. that when sufficient information has been gained on 2.5, 5, 20 and 25 Mc/s the experiments be extended to 10 and 15 Mc/s, one frequency at a time;

6. that in arranging the experiments the maximum practical advantage be taken of the properties of directional antennas, and of transmitter power adjustments, to assure good service with a minimum of interference;

7. that the administrations consider, as in the general interest, that no new permanent stations in the standard frequency bands be notified to the I.F.R.B. pending the report of the Study Group No. 7, and that no new experimental station be notified to

the I.F.R.B. without the agreement of the Study Group No. 7;

8. that the Study Group No. 7 arrange for trials of various desirable modulation frequencies, including 440, 600 and 1000 c/s, and should work out an optimum modulation programme, including time markers;

9. that the Study Group No. 7 consider the possibilities of single sideband operation, with full carrier;

10. that the carrier and modulation frequencies as transmitted be maintained within ± 2 parts in 10^8 of their nominal value;

11. that the standard time intervals and time signals preferably take the form of pulses of 5 cycles of 1000 c/s tone repeated at intervals of one mean solar second, synchronised as nearly as possible with reference to Universal Time, with the 59th pulse in each minute suppressed;

12. that the Study Group No. 7 seek the cooperation of the International Committee of Time in the provision of the time service;

13. that all standard frequency stations periodically and simultaneously interrupt their transmissions

to permit measurement of natural radio noise, and that a programme be worked out in cooperation with appropriate committees of the C.C.I.R. and U.R.S.I.;

14. that a code signal giving information on radio propagation disturbances be broadcast at regular intervals;

15. that the attention of appropriate committees of the C.C.I.R. and U.R.S.I. be drawn to the possible uses of standard frequency transmissions for propagation studies.

The study of this recommendation is assigned to Study Group No. 7.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Hungary, Roumania (Popular Roumanian Republic).

RECOMMENDATION No. 19

Organization of an International Monitoring Service

The C.C.I.R.

considering :

(a) that the rapid supply of accurate monitoring information, on a world-wide scale, is essential to the I.F.R.B. in the efficient performance of its duties, and to Administrations in the effective control of their radio services;

(b) that such monitoring information will be essentially required in respect of a vast number of radio stations of many types, including those operating short-range services on low power; and that, in such circumstances, a large number of monitoring stations spread throughout the world is necessary if the required measurements are to be quickly and accurately made;

(c) that the information at the disposal of the C.C.I.R. shows that large and important areas of the world are not at present provided with monitoring stations; and that, in consequence, the I.F.R.B. will have great difficulty in obtaining full and proper information from these areas, and especially from the Tropical regions where, on account of the high levels of atmospheric noise and the large number of low-power services in operation, the effective coverage of any individual monitoring stations is likely to be small;

(d) that in Art. 18 and Appendix C of the Radio Regulations of Atlantic City (1947), it is recognised that certain stations may not participate in the whole field of monitoring but may operate only within a limited part of that field;

(e) that, owing to the different characteristics of transmitters and the different techniques and operating procedures employed in the various types of radio services, it would be advantageous for the I.F.R.B. to receive regularly the results of measurements by specialised monitoring stations operated by personnel experienced in the type of service concerned;

(f) that, in particular, the radio stations of the mobile services, due to the special character of their exploitation and to the vital importance of certain categories of these stations for the safety of life at sea and in the air, should be systematically monitored and the results of the measurements transmitted to the I.F.R.B.;

(g) that the exchange of requests for, and the results of, measurements would be greatly facilitated if a single national Centralizing Office were designated in each country participating in a world-wide service of monitoring, in conformity with the provisions of Art. 18 of the Radio Regulations of Atlantic City (1947); that on the one hand a uniform distribution, between the monitoring stations of any country, of requests emanating from the I.F.R.B. and from Administrations and of actual measurements, and that on the other hand the distribution of actual measurements to the I.F.R.B. and to those Administrations would be facilitated through the agency of a single national Centralizing Office, thereby reducing the possibility of overloading certain monitoring stations and thus affording the possibility of expediting the clearance of harmful interference;

recommends :

1. that Administrations, recognized private operating agencies, and international organizations should participate forthwith in the establishment of a coordinated, world-wide, monitoring service;

2. that Administrations, recognized private operating agencies, and international organizations in the regions of the world where few, or no, monitoring stations at present exist, particularly in the tropical regions, should endeavour, as far as they are able and as soon as possible, to establish such stations in order to ensure efficient monitoring not only of long-distance but of short-distance transmissions and with a view to the operation of not less than six monitoring stations suitably distributed in each continent;

3. that some monitoring stations be principally devoted to the monitoring of mobile service transmissions and that their locations be chosen within the regions of the world where the density of such transmissions is the greatest and where harmful interference is most likely to be experienced;

4. that the Administrations of each country should designate, as far as they deem it possible and at an early date a single National Centralizing Office for

the exchange of all requests and information relating to the monitoring service;

5. that the attention of the Administrations is drawn to the need for rapid communications between the I.F.R.B. and the Centralizing Offices, between Centralizing Offices and between individual Centralizing Offices and the individual monitoring stations under their control.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation :

Bielorussian Soviet Socialist Republic, Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION No. 20

Accuracy of Frequency Measurements in Monitoring Stations

The C.C.I.R.

considering :

(a) the requirements of the I.F.R.B. in respect of the necessary frequency measurements for the efficient performance of its duties;

(b) the general availability of suitable monitoring equipments for frequency measurements;

(c) the desirability that the error of frequency measurement shall not exceed one-tenth of the tolerance specified in Col. 3 of the Atlantic City table of frequency tolerances (Appendix 3 to the Radio Regulations of Atlantic City, 1947);

unanimously recommends :

that monitoring equipments and procedures used shall be such that frequency measurements shall be made with an accuracy better than that specified in the following table:

Type of measurement	Accuracy
a) Measurement of the frequencies of stations, excluding broadcasting stations, operating in the band 10 kc/s - 4000 kc/s	$\pm$ 5 parts in 10^6 (or where this would be less than $\pm$ 2 c/s to an accuracy within $\pm$ 2 c/s
b) Measurement of the frequencies of broadcasting stations operating in the band 10 kc/s - 4000 kc/s	$\pm$ 2 c/s
c) Measurement of the frequencies of stations operating in the band 4000 kc/s - 50 Mc/s	$\pm$ 2 parts in 10^6

RECOMMENDATION No. 21

Field Strength Measurements by Monitoring Stations

The C.C.I.R.

considering :

(a) that it is desirable for monitoring stations to make field-strength measurements;

(b) the absence of precise data, from the point of view of propagation, concerning:

1. the desirable features of field measuring equipment;
2. the components of the field which should be measured;

(c) the urgent need of the I.F.R.B. to receive at least provisional data on which to base allocations and also with regard to interfering signals at frequencies up to at least 30 Mc/s;

(d) the absence of readily available equipment for making field strength measurements below 100 kc/s;

(e) that pending the further study of the subject, use may be made of the practical data now available;

(f) that the measurements could be influenced by the choice of location and that the accuracy might depend on conditions of reception to an extent which could not be easily assessed;

recommends :

1. that the field measuring equipment used by monitoring stations should be able to measure, under favourable conditions of noise, interference and

location, fields as low as 1 μV/m with an accuracy of $\pm$ 2 db in the 100 - 30,000 kc/s band;

2. that when, because of interference, unstable signals or for other reasons, measurements within these limits are impossible, monitoring stations shall submit such measurements as may be made;

3. that reports should include the following information:

(a) polarization of the field component measured;

(b) complete information in order to characterize the measured values;

(c) an estimation in all cases of the accuracy of measurement;

4. that studies relating to methods and equipment for field measurements should continue, taking into account the work of the study groups set up to examine propagation questions.

The Studies included in this Recommendation are assigned to Study Groups No. 6 and 8.

RECOMMENDATION No. 22

Form of Report for Frequency and Field-Strength Measurements Made at Monitoring Stations

The C.C.I.R.

considering :

the desirability of uniformity in furnishing monitoring data,

unanimously recommends :

1. that the form used in reporting frequency measurements should contain, at least, the following data:

(a) Serial number;

(b) Identification of the monitoring station (Administration or Organization and location);

(c) Date;

(d) Time (G.M.T.);

(e) Call letters and/or other means of identification of the measured station;

(f) Classification of emission;

(g) Assigned frequency or reference frequency;

(h) Frequency tolerance;

(i) Measured frequency;

(j) Accuracy of measurement;

(k) Deviation from assigned or reference frequency;

(l) Additional observations (e.g. period covered by measurement, drift of measured frequency during that period, quality of signal and conditions of reception, etc.);

(m) Remarks;

(n) Signature of responsible official of the Administration or Organization;

2. that the form used in reporting field-strength measurements should contain, at least, the following data:

(a) Serial number;

(b) Identification of the monitoring station (Administration or Organization and location);

(c) Date;

(d) Time (G.M.T.);

(e) Call letters and/or other means of identification of the measured station;

(f) Classification of emission;

(g) Assigned frequency;

(h) Value of measured field;

(i) Estimated accuracy of measurement;

(j) Polarization component;

(k) Other elements or characteristics of the measurement;

(l) Remarks;

(m) Signature of responsible official of the Administration or Organization;

3. that the I.F.R.B. should study the forms to be universally used in furnishing the foregoing data.

RECOMMENDATION N° 23

Signals MAYDAY and PAN

The C.C.I.R.

considering :

(a) that the results of the tests presented to the C.C.I.R. by the various administrations and the interpretation and discussions thereon, relating to the question of changing the radiotelephone distress signal MAYDAY and the radiotelephone urgency signal PAN indicate that some technical advantage may be gained in using SOS instead of MAYDAY as the distress signal;

that no such advantage, on the other hand, appears in the proposed use of URGENT instead of PAN;

(b) that, from the operational point of view, the signal SOS is used in radiotelegraphy and is known to laymen as well as to persons in the field of communications throughout the world as the distress signal;

(c) that, from the operational point of view, the association with the spoken signal SOS of an aurally recognizable signal, as proposed in Atlantic City Recommendation No. 6 to the C.C.I.R. (relative to ensuring the watch on the distress frequency 2182 kc/s by the aid of automatic devices), will tend to lessen any difficulty in changing from MAYDAY to SOS;

unanimously recommends:

1. that the international radiotelephone distress signal should henceforth consist of the three spoken letters S-O-S instead of the spoken word MAYDAY

pronounced as the french expression "m'aider";

2. that the present international radiotelephone urgency signal PAN be retained.

RECOMMENDATION N° 24

Relating to the Watch on the Distress Frequency of 2182 kc/s

The C.C.I.R.

considering :

(a) that it is practicable and desirable to establish a special alarm signal for the operation of automatic alarm devices on the frequency of 2182 kc/s;

(b) that the alarm signal shall be such as to permit transmitting means and receiving devices which are simple, rugged, dependable, stable in performance, of low cost, of easy world-wide production, of long life with a minimum of maintenance, and readily adaptable to existing double-side band radiotelephone equipments;

(c) that in addition to the requirement for reliable operation it is also essential that false operation shall be negligible;

(d) that to aid in clearing the distress frequency of other emissions, the alarm signal and detecting device must be capable of operation beyond the distance range at which speech transmission is satisfactory;

(e) that the automatic alarm device must be capable of operating in as short a time as possible, consistent with avoidance of false signals;

(f) that the choice of the alarm signal shall be such:

1. as to provide reliable operation of the alarm device,

2. as to provide a distinctive signal readily recognized aurally when received in loud speaker or headphones,
3. as to be capable of reception through interference by speech transmissions, through interference of other types and through noise,
4. as may be produced by a simple device, such as a whistle, as well as by electronic or other means;

(g) that an alarm signal depending essentially on interruption of the carrier wave is not satisfactory, since interference by continuous carriers may be present;

(h) that the alarm signal shall be formed by modulating the carrier wave with two or more frequencies in order to protect it against false operation. This modulation may be produced by one main modulating frequency, submodulated by a second frequency; or the modulating frequencies may be independently produced and transmitted either simultaneously or successively, depending on the system adopted;

(i) that the choice of modulating frequencies shall be such as to avoid:

1. interference from frequencies below 872 c/s, which is the maximum beat frequency between two interfering carriers, each being within the tolerance of ± 0.02 per cent (relative to 2182 kc/s),
2. interference from strong components of speech which occur around 400-500 c/s,
3. interference from the fundamental and harmonics of existing signalling systems which might cause false operation of the alarm devices or be confused with the alarm signal during aural reception, (i.e. 600, 1200, 1500, 1800 and 3000 c/s),
4. interference from the second harmonics of broadcasting stations operating on 1090 kc/s, which

results in the generation of beat frequencies between 1540 and 2450 c/s approximately. (These figures may need reconsideration after the revision of European broadcast frequency allocations);

(j) that the modulation frequencies shall be chosen within the passband of normal ships'radio telephone transmitting and receiving equipment;

(k) that if time coding is used, it should be simple and should not involve close tolerances;

(l) that any selective calling system used on the frequency of 2182 kc/s, (whether combined with, or entirely separate from, the automatic alarm equipment), must not employ signals which might be confused with the alarm signal or result in false operation of the automatic alarm;

(m) that both the system proposed by the United States and the modified system of the United Kingdom considered at the C.C.I.R. Meeting at Stockholm warrant further study;

recommends :

1. that further tests be made before the form of signal and specification of apparatus for standardization on a world-wide basis can be finally determined; and the results of these tests be communicated, for the purpose of coordination, to the C.C.I.R.; 1)

2. that the administrations and operating agencies concerned take part in these tests to determine:

(a) The general suitability of the automatic

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1) The results of these tests and the recommendations should be circulated to all members of the C.C.I.R. not later than August 1, 1949.

alarm signal and receiving device recommended by the United States in Documents No. 25 E and No. 35 E of the Vth Meeting of the C.C.I.R.;

(b) The characteristics and performance of any automatic alarm systems considered by the C.C.I.R. to offer real advantages over the system referred to under (a).

The studies included in this Recommendation are assigned to Study Group No. 9.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Bielorussian Soviet Socialist Republic, Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Albania (Popular Republic of), Bulgaria (Popular Republic of).

RECOMMENDATION No. 25

Standardisation of Radiophoto and Telephoto Equipment

The C.C.I.R.

considering :

(a) that it is desirable to standardise the characteristics of apparatus employed for phototelegraph transmission over long distances on H.F. radio circuits;

(b) that such standardisation is urgently necessary in order to guide the production of new types of apparatus, and thus to lessen and ultimately eliminate the present difficulties encountered in interworking;

(c) that it is desirable to standardise certain characteristics of the apparatus in such a way that it will be equally suitable for transmission over metallic circuits;

(d) that the C.C.I.T. having had under consideration the subject of the transmission of half-tone pictures over mixed metallic and radio circuits, has issued a recommendation as yet unnumbered in the C.C.I.T. series but which is contained in document No. 84 of the Fifth Meeting of the C.C.I.R. and has, moreover, outlined certain questions which in the opinion of the C.C.I.T. should be studied by a mixed Commission of the C.C.I.T. and C.C.I.R.;

(e) that

1. the transmission system of amplitude modulation is unsatisfactory over H.F. radio circuits because of the intolerable fading ratio invariably encountered;

2. the time modulation system gives insufficiently good definition;
3. the system of direct frequency modulation of the radio frequency carrier is not yet sufficiently developed for the transmission of half-tone pictures owing to the high stability necessary in the received frequencies representing the picture tones;
4. the system of subcarrier frequency modulation has proved satisfactory but requires standardisation in respect of the subcarrier and deviation frequencies having regard to the value of picture keying frequencies to be transmitted;
5. taking into account the degree of tolerable distortion, the effect of multipath echoes on long distance H.F. radio circuits normally limits the maximum admissible picture keying frequency to approximately 600 c/s, and that this frequency conforms with the use of the following characteristics:

	(a)	(b)
Index of cooperation	352	264
Speed of rotation of cylinder in r.p.m.	60	90

recommends :

1. that the subcarrier frequency modulation system be used with the following characteristics:

(a) subcarrier frequency 1900 c/s
white frequency 1500 c/s
black frequency 2300 c/s

(b) Stability of frequencies should not be greater than:

Instantaneous, 8 c/s

During 15 minutes, 16 c/s

2. that, for the present, the following characteristics be used:

	(a)	(b)
Index of cooperation	352	264
Speed of rotation of cylinder in r.p.m.	60	90

3. that direct frequency modulation of the radio carrier by the picture modulation frequencies would result in a greater signal to noise ratio for a given transmitter and that the perfecting of this system be studied;

4. that a mixed commission C.C.I.T. - C.C.I.R. be established to study and make recommendations for the standardisation of characteristics, including:

(a) cylinder dimensions;

(b) alternative speeds of rotation;

(c) effects of land line characteristics in the case of transmission over combined metallic and radio circuits;

(d) desirable relation between picture light density and deviation frequency in the system of frequency modulated sub-carrier.

The Study included in this Recommendation is assigned to

Study Group No. 9

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Bielorussian Soviet Socialist Republic,
Union of Soviet Socialist Republics.

RECOMMENDATION N° 26

Abbreviations.

The C.C.I.R.

considering :

(a) that the subject of a standardised vocabulary of radioelectric terms was discussed at the 5th Meeting (Stockholm, 1948)

(b) the subject of names, abbreviations and symbols is of common concern to C.C.I.R., C.C.I.T., C.C.I.F., and all organizations of the I.T.U.

(c) there exist already several bodies, some international and some national, which have endeavoured to standardise names, abbreviations and symbols, e.g.

The International Electrotechnical Commission,
Le Bureau International des Poids et mesures,
The Institute of Radio Engineers,
The American Standards Association,
The British Standards Institution,
Comitato Elettrotecnico Italiano (C.E.I.)

unanimously recommends :

that the Administrative Council of the Union arrange for the compiling of a special vocabulary of names, symbols (both literal and graphical), and abbreviations of interest in the radio art.

RECOMMENDATION N° 27

Methods of Measurement and Limits of Tolerances for Interference Caused to Broadcasting by Electrical Installations

The C.C.I.R.

considering :

(a) that there is no need to resume within the C.C.I.R. the study of methods of measurement since this question has already been entrusted to the Special International Committee of Radio Interference (C.I.S.P.R.), founded under the auspices of the International Electrical Commission (C.E.I.);

(b) that the C.C.I.R. should keep in regular contact with the C.I.S.P.R. and send a representative to the meetings of this latter Committee;

(c) that in view of the importance of the work undertaken by the various countries since the last meeting of the C.I.S.P.R., and which still remains unpublished, a detailed study of the results obtained by that Committee cannot be usefully carried out at this Meeting;

(d) that the measuring equipment designed by the C.I.S.P.R. may prove useful for the study of disturbances other than those caused by electrical apparatus, for example by atmospherics;

(e) that the measurements should be extended to disturbances due to causes other than signals produced by transmitters;

(g) that, in this respect, the most urgent problem relates

to the disturbances affecting television receivers and caused particularly by other radio receivers, electrical ignition systems, industrial, scientific and medical equipment producing hertzian radiations;

(h) that, in consequence, the means of measurement is to be extended to all the frequency bands used for sound and visual broadcasting;

(i) that the work of the C.I.S.P.R. should be directed according to the four preceding paragraphs;

(j) that with regard to the precautions to be taken for electrical apparatus and installations and radio equipment, collaboration is essential between the administrations and the organisations representing electrical industry, on the one hand, and broadcasting on the other hand;

recommends :

1. that the C.I.S.P.R. maintain regular contact with the C.C.I.R. and admit a representative of the C.C.I.R. to its meetings;

2. that, if necessary, the C.I.S.P.R. take in consideration the suggestions by the C.C.I.R. regarding the relative urgency of the work carried out in various fields;

3. that, in particular, C.I.S.P.R. pursue actively its work on interference caused to television receivers by other receivers, ignition systems, and industrial, scientific and medical equipment producing hertzian radiations.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the Ukrainian Soviet Socialist Republic declared that it did not accept this recommendation.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Bielorussian Soviet Socialist Republic, Hungary,
Roumania (Popular Roumanian Republic),
Union of Soviet Socialist Republics.

RECOMMENDATION N° 28

High Frequency Broadcasting Bandwidth of Emissions

The reasons which justify the attached Recommendation are given in annex.

The C.C.I.R.

recommends :

1. that there is no evidence that, under the present day conditions, sensibly increased interference between broadcasting stations is caused by the use of modulating frequencies between 5000 and 6400 c/s, when the channel separation is 10 kc/s;

2. Nevertheless recommends that broadcasting stations with assigned frequencies near the edge of the bands allocated to broadcasting, should be so adjusted that none of the side band frequencies fall outside the broadcasting bands.

ANNEX

Listening tests have been made in connection with this investigation on the quality obtainable on short-wave and the effect of reducing the frequency band occupied. From the tests made it is considered that, although there will be some loss in audio frequency quality in restricting the highest modulating frequency to 6,400 c/s, the loss is not serious. Tests have also been made in further restricting the band of frequencies to 5,000 c/s. The loss of quality in this further restriction is quite noticeable.

The principal causes of unsatisfactory reception of short-wave signals in decreasing order of importance are considered to be:

(a) fading and particularly selective fading resulting in heavy distortion,

(b) insufficient signal/noise ratio at the receiving point,

(c) heterodynes between carrier frequencies,

(d) heterodynes between sidebands of different stations or between a sideband of one station and the carrier of another, due to a sideband of frequencies being transmitted.

In the last case it has sometimes been found that the actual difficulties arise more from harmonics and spurious radiations generated during the process of modulation at the transmitter than from the actual fundamental modulating frequency components themselves.

Of the above causes the first two are outside the scope of the present question. The third cause will be eliminated when all stations move to fully planned frequency allocations, while in the case of the fourth cause, a considerable amount of remedy is in the hands of the listener, who can usually so restrict the bandpass characteristics of his receiver as to

eliminate or reduce interference. It would be regrettable to eliminate desirable frequency bands from transmissions unless clearly necessary and effective in eliminating interference in particular cases.

The conclusion reached is that it is desirable to maintain the normal bandwidth of modulating frequencies at an upper limit of 6,400 c/s.

In order to make bandwidth restrictions as effective as possible, steps should be taken to minimize the radiation of harmonic and intermodulation products in the transmitter and to avoid overmodulation with its inherent production of spurious frequencies.

To consider in some detail the effect in a receiver, the interfering signal is assumed to be a high frequency broadcasting double sideband signal with modulating frequencies to and including 6,400 c/s, and with the carrier 10 kc/s removed from the desired carrier. The extra band radiation (distortion) of the high frequency broadcasting signal shall not exceed 5%, and thus the extra band radiation falling within the band of the desired signal will be approximately 32 db below the level of the undesired carrier.

The receiver to be considered is the type in general use by the public. Comparison of a number of such receivers has indicated an average selectivity curve which will apply both to European and American receivers, and most employ a diode for demodulation.

The average selectivity curve of such a receiver indicates that a signal 10 kc/s removed from the centre of the pass band (assumed position of the desired carrier) will be attenuated 24.4 db. The curve further shows that a signal 5 kc/s removed will be attenuated 8 db, and a signal 3.6 kc/s removed (6.4 kc/s sideband) will be attenuated 5.1 db.

Before considering the actual interference reproduced by the receiver it should be noted that the relatively simple problem of a carrier and two sidebands demodulated by a diode becomes a complex problem when only one sideband reaches the diode or when the amplitude or phase of the carrier and sidebands is altered. Of primary importance to this problem is the further fact that when a carrier is present at the diode, if another carrier is also applied at a lower level, the resultant output is less than either signal. This effect may be analyzed by the use of Bessel functions indicating that as the ratio of desired to undesired input to the diode is increased the ratio of desired to undesired output increases much more rapidly.

Assuming no pre-emphasis at the transmitter, and a ratio of desired to undesired signal of 1, the average receiver would admit a 5 kc/s undesired signal to the diode 22.2 db below the desired carrier. Similarly, the 6.4 kc/s interfering sideband would be 21.1 db below the desired carrier and the diode output signal would be more than 40 db below the desired output signal at 100% modulation. The exact value of the diode output is complicated by the fact that the diode linearity varies with input signal and that, in most cases, the diode load varies with audio frequency. However, at desired to undesired signal ratios of one or greater, and without pre-emphasis, interference should not be caused.

If receivers are improved, and a much lower ratio of desired to undesired signal is then adopted, a point will be reached where interference will be caused by the part of the interfering signal which lies within the receiver pass band.

It has been shown that under usual circumstances the amplitude of the interference should not be troublesome. It may be further noted that the interfering signal will usually beat with the desired carrier and therefore be inverted, the

CORRIGENDUM

The following modifications must be made to the Book of Recommendations and Questions of the C. C. I. R.

page 99 (Recommendation nº 28),

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, which were committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they did not accept this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

6,400 c/s modulation becoming 3,600 c/s interference. The interfering signal would not be intelligible to the listener, and it has been shown that such interference is more easily tolerated than intelligible interference.

At the present time there is no evidence that interference will be caused to the average receiver due to the transmission of normal signal intensities in those portions of the sidebands 5 to 6.4 kc/s removed from the carrier. It does not appear that a reduction in the desired to undesired signal ratio will change this conclusion with respect to present receivers. However, the use of pre-emphasis, more selective receivers and modified signal ratios, or a combination of these, may cause the transmission of energy at modulating frequencies up to 5,000 c/s and 6,400 c/s respectively, to assume new importance.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

RECOMMENDATION N° 29

TELEVISION STANDARDS

The C.C.I.R.

considering :

(a) that the interchange of television programmes between countries is desirable;

(b) that the interchange of such programmes should be done in an economical manner;

(c) that the economical interchange of television programmes would be facilitated by the adoption of agreed standards for certain characteristics of transmissions;

(d) that technical standards should be coordinated, insofar as possible, to permit such interchange to facilitate the utilization of receiving equipment, and to minimize mutual interference between television services;

(e) that the adoption of such standards will result in the most rapid expansion of the television service, by making more readily available a wider variety of programmes and, in addition, giving a reduction in programme costs;

(f) that it is desirable that world-wide agreement be obtained on those standards which would permit interchange of programmes, both direct and recorded;

(g) that the interchange of programmes will be effected by radio relay and cable links for direct programmes, and by film for recorded programmes. With interchange between different linguistic groups the sound channel characteristics are of secondary importance, and primary attention needs to be placed on the vision signal;

(h) that the question of programme interchange is also linked with the desirable technical characteristics necessary to provide :

1. a satisfactory service in the home at reasonable cost;
2. a reasonable service in the home at minimum cost;

(i) that in consideration of these problems account should be taken of the following factors:

1. the available bandwidth allocated to Television is limited;
2. importance is to be attached principally to the cost of receivers rather than that of transmitting equipment;
3. the proposed standards should not preclude in due course, the possibility of reception, by the addition of a suitable frequency converter, of the following:

   monochrome pictures on a "black and white" receiver of the transmissions from a "colour" transmitter,

   monochrome pictures on a "colour" receiver of transmissions from a "black and white" transmitter;

(j) that the adoption of transmission standards on as wide a basis as possible will result in the most rapid expansion of the television service, in that it will facilitate the production of receivers at lower cost;

(k) that a factor of prime importance in arriving at world standards is the problem of operating a television service in which the frame repetition rate is not integrally related to the power supply frequency;

(l) that it is inevitable that there will be considerable channel sharing in the existing television bands, and therefore,

in view of long distance propagation effects, it is desirable that the standards proposed should be such as to minimize interference between stations.

recommends :

that there be undertaken the study of, and publication of Recommendations on the technical factors which would assist in achieving:

(a) Interchange of programmes on the widest possible scale,

(b) Coordination of standards to permit the use of a receiver on transmissions differing in a minor degree.

The factors which appear of major importance are:

1. For the interchange of direct programmes:
   (a) Frame repetitions rate,
   (b) Frame interlacing,
   (c) Number of lines,
   (d) Aspect ratio;
2. For the interchange of recorded programmes:
   (a) The programmes should be recorded in such a manner as to make them capable of being reproduced on standard 35 or 16 mm motion picture sound equipment.
   (b) The effects of pattern interference due to transmission of a film on a

television system having a different number of lines from that on which the film was recorded;

Among other factors which should be studied to permit interchange of receivers are the following:

(a) Polarity of modulation for vision signal,

(b) Distribution of channels in the available spectrum space,

(c) Relative frequencies of sound and vision carriers and the positioning of these carriers and associated sidebands within the channel,

(d) Type of vision transmission, e.g. double sideband, single sideband, etc.,

(e) Type of modulation of sound channel,

(f) Form of synchronizing signal,

(g) Non-integral relationship between frame repetition rate and power frequency.

Note 1. Several of the points (a) to (f) are referred to in question No. 25.

Note 2. It is realised that due to certain technical factors such as different power supply frequencies and different frequency allocations to television in the various regions, world-wide standardisation may be delayed for a considerable time, but in view of the rapid development expected for

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they wished to reserve their opinion with regard to this recommendation :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

television in the next few years urgent attention should be given to the solution of the problems on as wide a geographical basis as possible, with a view to the early formulation of agreed standards.

Note 3. It is recommended that in respect of the characteristics of international circuits for television programme transmissions the C.C.I.F. should coordinate its work with that of the C.C.I.R.

The studies included in this recommendation is assigned to Study Group 11.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this recommendation:

Albania (Popular Republic of), Bulgaria (Popular Republic of).

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this recommendation:

Bielorussian Soviet Socialist Republic, Hungary, Roumania (Popular Roumanian Republic), Union of Soviet Socialist Republics.

RECOMMENDATION No. 30

Draft Budget of the C.C.I.R.

The Plenary Assembly of the C.C.I.R. proposes to the Administrative Council of the I.T.U. that the budget of the C.C.I.R. shall be approved for a total amount of

439,250 Swiss Francs for the year 1949
412,550 Swiss Francs for the year 1950

in conformity with the table attached hereto.

Draft Budget of the C.C.I.R.

	Year 1949	Year 1950
1. Personnel		
(a) Director	51,600	51,600
(b) Vice-Director	45,150	45,150
(c) Permanent Personnel	202,400	202,400
(d) Social Security Family Allowance Expatriation Allowance (estimated at 25% of the salaries)	74,750	74,750
(e) Cost of transfer and recruitment estimated at 15% of the salaries	44,850	-
	418,750	
Deduction for the year 1949, the full staff not being already employed on the 1st January 1949 but being engaged gradually in the course of 1949	69,750	
	349,000	373,900
2. Rental (including heating, cleaning, lighting)	8,600	8,600
3. Office overhead expenses (including supplies, telephones, etc.)	4,300	4,300
4. Travelling expenses	17,200	17,200
5. Initial Cost of Establishing Geneva Office		
(a) Office installation, cost of repairs of building, etc.	17,200	-
(b) Office furniture and equipment	34,400	-
6. Miscellaneous	8,550	8,550
	439,250	412,550

Remarks

1. The estimated total permanent staff includes

2	engineers
1	secretary administrator
3	technical editors
1	technical employee
3	monolinguistic stenotypists
4	bilinguistic stenotypists
2	clerks
2	filing clerks
18	persons

2. For the year 1950 items 1 (e) and 5 can be deleted, resulting in a total budget figure for 1950 of Sw.Fr. 412,550.-

RECOMMENDATION No. 31

Contribution to the Expenses of the Stockholm Meeting.

The C.C.I.R., with reference to Resolution No. 21 of the Administrative Council of the I.T.U.,

unanimously recommends :

1. that the contributions of the countries, the recognised private operating agencies and the international organizations participating in the Vth Meeting of the C. C.I.R. at Stockholm must conform to the stipulations of paragraphs 3 and 4 of Article 14 of the Atlantic City Convention;

2. that the International Committee of Time shall be exempt from any contribution to the expenses of the Vth C.C.I.R. Meeting in Stockholm.

RECOMMENDATION No. 32

Use of Simultaneous Interpretation

The C.C.I.R. with reference to the question set by the Administrative Council in Resolution No. 21, para 4, sub-para (b), worded as follows:-

Should the simultaneous interpretation system be used for the sessions of the Plenary Assembly and/or the Study Groups ?

unanimously recommends :

that in principle there is reason to use simultaneous interpretation only for the sessions of the Plenary Assemblies, and for Committees and Study Groups attended by a large number of members.

RECOMMENDATION N° 33

Regarding the Method of Dispatch of Reports by Reporters of Study Groups to the Group Chairman and by the Group Chairmen to the Director of the C.C.I.R.

The C.C.I.R.

considering :

the fundamental interest in ensuring that the reports of the Study Groups reach the Director in good time to be in accord with the time limit stipulated in Chapter 13, paragraph 3 of the General Regulations (Atlantic City, 1947);

unanimously recommends :

1. that the Reporters of each Study Group shall send their contribution to the Group Chairmen at least 6 months before the date of opening of the C.C.I.R. Plenary Assembly.

2. that the Group Chairman shall send their reports to the Director of the C.C.I.R. so that he receives them at least 4 months before the date of opening of the C.C.I.R. Plenary Assembly.

3. that the Director shall dispatch the documents in such a way that they may reach the Members preferably two months before the date of the meeting of the Plenary

Assembly and in any case at least one month before this date in accordance with Chapter 13, paragraph 3 of the General Regulations (Atlantic City, 1947).

4. that as a general rule, no report prepared in connection with Study Group work will be considered, which is sent directly to the Director instead of being sent to the appropriate Group Chairmen.

RECOMMENDATION No. 34

to be submitted to the Administrative Council of the Union.

The C.C.I.R.

considering :

(a) that for the studies entrusted to the C.C.I.R. it would be useful to have an accurate terminology and a standard system of letter symbols and graphical symbols;

(b) that the technical terms and symbols relative to radiocommunications are, to a great extent, similar to those used in telephony and telegraphy;

(c) that cooperation with the C.C.I.F. and the C.C.I.T. would be of interest to the C.C.I.R. with a view to drawing up a common telecommunication vocabulary and a list of symbols;

unanimously recommends :

that the Administrative Council examine, together with the directors of the three International Consultative Committees, the possibility of setting up, with the aid of the Secretariats of these three Committees and of the general Secretariat of the Union, a permanent common study group to carry out this task in agreement with other international organizations;

considering, on the other hand :

(a) that the C.C.I.R. has been approached on the question of the application of the Brussels universal system of decimal classification to radiocommunication, and

(b) that nevertheless other systems of decimal classification, which are used for radio matters, exist at present;

unanimously recommends :

that the Administrative Council examine also, with regard to the creation of the above mentioned special group, the advisability of entrusting this group with the study of the possibility of applying decimal classification systems to radio.

RECOMMENDATION No 35

Expenses of Study Groups

The C.C.I.R. with reference to Recommendation No 22 of the Administrative Council concerning the expenses of the Study Groups in the period between two Meetings of the Plenary Assembly

unanimously recommends :

that the expenses of each Study Group of the C. C.I.R. in the period between the Vth and VIth Meetings of the Plenary Assembly of the C.C.I.R. shall be charged to Administrations, recognised private operating agencies and international organisations participating in the work of such Study Group.

LIST OF QUESTIONS TO BE STUDIED

QUESTIONS N° 1, 2 & 3

Revision of Atlantic City Recommendation N° 4

The C.C.I.R.

considering :

that to give maximum effectiveness to the studies requested by the International Radio Conference of Atlantic City (1947) in its recommendation No. 4 to the C.C.I.R. it is expedient to re-arrange this recommendation and incorporate the relevant Bucharest questions;

unanimously decides :

A. that the text of Atlantic City Recommendation No. 4 be rearranged and extended as follows:

Question No. 1

(Study Group No. 1)

In respect of the various classes of emission in use, determination of:

(a) the bandwidth strictly necessary to ensure a service of the appropriate quality, practical methods of measuring the bandwidth actually occupied by each emission;

(b) the level of radio-frequency harmonics radiated by the stations of the different services,

the level to which it is practicable to reduce such harmonics,
the methods of achieving this result,
the corresponding methods of measurement;

(c) study of improved methods of obtaining frequency stability in transmitters.

Question No. 2

(Study Group No. 2)

Determination of:

(a) the bandwidth which should be accepted by the various types of apparatus used for the reception of different classes of emission in the different services,
the filter characteristics and especially their effectiveness in eliminating interference outside the nominal acceptance band,
the practical methods of obtaining the necessary characteristics;

(b) the noise and sensitivity of the various types of apparatus used for the reception of different classes of emission in the different services;

(c) the corresponding methods of measurement.

Question No. 3

(Study Group No. 3)

(a) Consideration of the desirable conditions to be fulfilled by the complete systems employed by the different services in order to determine the required technical performance of the equipment (including the station terminal apparatus and the antennas) and of the measuring apparatus used to ascertain whether the equipment satisfies the recommendations of the C.C.I.R.;

(b) Consideration of the field strength intensity necessary for the reception of different classes of emission in the different services,

(c) Consideration of the effect of frequency stability of transmitters on the minimum practicable spacing between stations.

(d) Consideration of the minimum practicable spacing between the frequencies of stations operating in adjacent channels for different classes of emission in the different services.

B. that the three above questions be studied simultaneously and with the same urgency,

C. that questions 1,4,11,14,16,17 of Bucharest

be removed from the list of questions to be studied by the C.C.I.R.

and unanimously decides :

to carry on permanently the study of the above-mentioned questions and to publish its recommendations and possible revisions as soon as practicable.

QUESTION N° 4

Interference in the bands shared with broadcasting(1)

(Study Groups No. 3 and 12)

(The reasons which justify this question are given in an annex)

The C.C.I.R.

considering :

Recommendation No. 8 of the International Radio Conference (Atlantic City, 1947) and the studies pursued at the Vth Meeting of the C.C.I.R. (Stockholm, 1948);

unanimously decides that the following question be studied :

1. What power limitations is it appropriate to impose on radiotelegraph stations in tropical zones, in the shared bands ?

Will it be appropriate to impose on A3 emissions limitations similar to those that might be imposed on broadcasting stations as a result of studies in connection with question No. 27 ?

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(1) This question is referred to Study Group No. 12 (Tropical Broadcasting) as regards the points directly concerning broadcasting in the tropical zones, and to Study Group No. 3 as regards the study of other points..

2. Should the P.F.B. allot in tropical zones, for sharing services in the broadcast band, only frequencies nominally mid-way between broadcasting carrier assignments ?

3. Is it necessary that the Administrations attempt to improve as soon as possible the frequency stability of fixed stations within the shared bands to the values specified in Column 3 in Appendix 3 of the Atlantic City Radio Regulations ?

Is it necessary that they operate transmitters which do not meet this requirement only on frequencies outside the shared bands ?

4. Should Administrations avoid the operation of mobile stations in tropical zones within the bands shared with broadcasting (particularly as regards the use of A3 emissions from such mobile stations) ?

5. Should an effort be made by the Administrations to comply at the earliest possible date with the provisions of Article 13, paragraph 3 in the Radio Regulations of Atlantic City (1947), concerning the location of stations and the use of directional antennae ?

6. What is the minimum permissible protection ratio of a broadcasting station, when measured at the output of a receiver having an audio frequency cut-off of 6.4 kc/s ?

and to what minimum value of the wanted field should this ratio be maintained ?

7. Is it necessary that Administrations take steps to ensure that all interference produced by radiation, such as key-clicks, sideband spread, etc., be kept to a minimum ?

- ANNEX -

1. The permissible frequency tolerances for broadcasting stations would permit variations in frequency of broadcasting stations up to about 250 c/s until 1953 and up to about 150 c/s after that date. The corresponding tolerances for fixed stations would allow maximum frequency changes of about 500 c/s and 150 c/s respectively. The tolerances permitted to mobile stations would be initially about 2500 c/s and later about 1000 c/s. These tolerances are very large in relation to the possible spacing between broadcast carrier frequencies in the shared bands and, for a consideration of the problem, it is therefore necessary to assume a frequency spacing between such broadcast carriers.

2. If it is assumed that the stations of other services will be located only on frequencies centrally located between the broadcast carriers, and if it is further assumed that the broadcast carrier frequencies will be separated not more than 10 kc/s, then the maximum frequency spacing between a fixed or mobile station and a broadcasting station would be 5 kc/s. From this consideration it will be seen that the permissible tolerances represent a very large proportion of the spectrum space between a broadcasting carrier and a sharing service carrier and that the possible heterodyne frequency will be such that a receiver giving adequate broadcasting reception would not eliminate it. At the

present time, it would seem very difficult greatly to increase the stability of mobile transmitters and it is therefore suggested that a case exists for recommending to administrations in tropical zones that the minimum number of mobile stations should be assigned in the shared bands. For fixed stations it would seem that since by 1953 fixed stations in these bands will have to maintain the same frequency tolerances as broadcasting stations, as specified in Appendix 3 to the Atlantic City Radio Regulations, that it would be advisable to request administrations to expedite improvement in the frequency stability of fixed stations in bands shared with broadcasting and that the minimum number of fixed stations in tropical zones might be assigned in these shared bands, unless they do meet the requirements laid down for frequency tolerance for broadcasting stations.

3. If it is not possible entirely to eliminate mobile stations from the shared bands in the tropical zones, then it might be recommended that every effort should be made to eliminate the use of mobile stations using A 3 type of transmission in these bands. As in other services, fully adequate telephony quality is maintained with a reduced audio frequency bandwidth, it might be recommended that the audio bandwidth transmitted by mobile stations when operating in the tropical zones should be limited to 3000 c/s.

4. In the Vth Meeting of the C.C.I.R. Document No. 110, it is recommended that power limitations should be placed on broadcasting stations operating in these bands. It is generally admitted that the field strength required for an adequate telegraph service is of the order of 10% of the field required for an adequate signal on a broadcast service. There would seem, therefore, to be a logical case to put a restriction on the power to be used by other services in the shared bands. All voice transmission in this band might possibly be carried out on power limits not exceeding those laid down for broadcasting stations

in the C.C.I.R. Document No. 110.

5. A recommendation might be made in accordance with Art. 13, Para. 3 of the Atlantic City Radio Regulations that the use of directive antennae be followed in all possible cases in order to reduce mutual interference between services.

6. As is pointed out in the Vth Meeting of the C.C.I.R. Document No. 21 on page 5, the permissible interference level for ordinary telephony with noise reducers is + 32 db and for ordinary telephony without noise reducers + 42 db. For broadcasting use, higher signal to noise ratios are suggested. It is felt, however, that it would be a matter of considerable difficulty under tropical conditions to obtain a signal to noise ratio greater than 40 db with respect to the local noise. Such a level has been taken as a reasonable maximum in the C.C.I.R. Document No. 110. It is considered, therefore, that it is not justifiable to specify limits of interference more stringent than that imposed by a protection ratio between wanted service and interference of 40 db. It might be suggested, therefore, that an undesired signal should be defined as causing interference to a broadcasting service only when its effective level in the output of an ordinary receiver having an audio band-pass of 6.4 kc/s is less than 40 db below the desired signal level within the defined service area of the broadcasting station.

7. To minimize the effect of interference, a recommendation might be made that spurious radiation, key-clicks, side-band spread and other forms of interference producing radiation should be kept to a minimum in all transmitters used in tropical zones on the shared bands.

8. While it is considered that, under normal conditions, a modulation band of 6,400 c/s is desirable in the interests of quality, it is recognised that, in the tropical zones, the levels of atmospheric noise in the tropical broadcasting bands and the possibilities of interference due to the difficulty of

accommodating all stations in these bands are such that a modulation band of 5000 c/s may have to be accepted.

QUESTION No. 5

Study of Medium and Long Wave Propagation
(Study Groups No. 4 & 6)

The C.C.I.R.

considering :

that the use of medium and low frequencies (10 to 1000 kc/s) for navigational aids has emphasised the need, already evident from other sources, for a better understanding of the propagation on these waves;

unanimously decides that the following question be studied :

Study of Medium and long wave propagation.

For this study, it is recommended that apart from the investigation of ground wave propagation as described in question No. 6, the detailed theoretical and experimental study of the transmission of waves of the above frequencies through the ionosphere in all parts of the world should be continued and extended with special reference to:

(a) diurnal and seasonal variations in field strength and direction of arrival;

(b) the zones of interference of ground and ionospheric waves;

(c) the stability of both phase and time of transit of waves propagated through the ionosphere.

QUESTION No. 6

Ground Wave Propagation

(Study Group No.4)

The C.C.I.R.

considering :

the continuing importance of the effect of the characteristics of the earth on the propagation of waves used for all types of radio communication and location, including directional transmission and direction finding;

unanimously decides that the following question be studied:

Ground Wave Propagation

and for this study recommends :

that the 1938 C.C.I.R. curves of ground wave propagation be revised and extended to cover the whole of the radio frequency spectrum now in practical use, giving particular attention to :

1) transmission over mixed paths, e.g. partly over land and partly over sea;
2) the effect of hills and other obstacles in diffracting the waves in either the horizontal or vertical plane;
3) the siting of aerials for very high frequency

4) the relative effects obtained with horizontal and vertical polarization;

5) the variations in phase of radio waves in transmission over ground between two points.

QUESTION N° 7

Propagation of Waves at Frequencies Between 30 Mc/s and 300 Mc/s

(Study Groups No 4,5 and 6)

The C.C.I.R.

considering :

(a) that frequencies in the band 30 Mc/s to 300 Mc/s, are of great importance for short distance radio links, for television, for broadcasting and for other purposes, and

(b) that, while waves on such frequencies are propagated to useful distances beyond the horizon by diffraction round the earth, they are also at times influenced by tropospheric and ionospheric conditions;

unanimously decides that the following question be studied:

Propagation of waves of very high frequencies (30 Mc/s to 300 Mc/s) under conditions of:

1. ground-wave transmission, as recommended in question No 6 dealing with ground-wave propagation;
2. transmission through the troposphere, as recommended in Recommendation No 15 dealing with tropospheric propagation; and
3. ionisation in the E and F regions of the ionosphere, such as may lead to transmission

of these waves to great distances.

Such a study should have regard to the need for increasing knowledge of the times and places of occurrence of the various types of transmission phenomena detailed above, and of the resulting effect of such occurrences on practical radio services.

QUESTION No.8

Measurement of Field Strength of Radio Signals

(Study Groups Nos 4,5 & 6)

The C.C.I.R.

unanimously decides that the following broad question be studied :

Methods of measuring the field strength of radio signals, considering first the simplest case of a steady wave of known plane polarisation and of constant amplitude.

Directives for the investigations to be pursued:

A. The following points are suggested for immediate investigation :

1. The best methods for expressing the field strength for :

(a) continuous wave transmissions;

(b) modulated continuous wave transmissions;

(c) pulse transmissions;

(d) suppressed carrier transmissions;

2. The frequency bands in which the measurements are most immediately needed;

3. The type of wave collected and equipment for use in each frequency band;

4. The desirable and the attainable accuracy of

measurement for each frequency band (the attainable accuracy may vary with the magnitude of the field being measured);

5. The influence of local conditions on the interpretation and accuracy of the measurements.

6. The merits of the two main types of equipment now in use, viz:

a) that in which the locally generated signal is injected directly into the receiving circuit;

b) that in which a locally generated field is applied to the wave collector of the measuring equipment;

7. The merits of a standard noise generator as the source of the locally generated signal.

B. It is further recommended that organisations interested in this subject should exchange descriptions of the apparatus they have developed and should arrange for intercomparisons so far as may be practicable.

C. When the position of the technique of field strength measurement has been clarified by studying the matter described above, attention should be given to the application of the resulting knowledge to the requirements of radio engineering of all kinds.

This would include a complete analysis of the field

to be measured, and a study of the best methods of measurement in order to obtain data most suitable for statistical analysis.

D. In connection with this subject, attention is drawn to the work of the U.R.S.I. as recorded in the proceedings of the VIIth General Assembly held in Paris in 1946. (Proc. U.R.S.I. 1946 Vol. VI P.54).

QUESTION N° 9

Measurement of Natural Noise

(Study Groups No. 5 and 6)

The C.C.I.R.

unanimously decides that the following question be studied :

In stating noise levels in connection with the determination of the signal level required, how is the noise measured and what is the significance of the measurement in relation to the peak values which are exceeded for only a very small percentage of time ?

For example, it is fairly well recognised that, in the case of thermal noise, the peak value of the noise as measured on a large variety of measuring instruments exceeds the r.m.s. value by some 12 db. In the case of isolated static do not the instruments commonly used record something which may approach the r.m.s. value during the period of excitation, but which, over a time period of, say, 5 seconds would not record the true r.m.s. value ? In somewhat more detail, do the instrument readings approximate more nearly to the ballistic effect of the isolated static than to the r.m.s. value.

Finally, do the instruments used for measuring

noise contain anything resembling weighting networks which are intended to equalise the results of measuring various types of noise.

QUESTION N° 10

Atmospheric Noise Data

(Study Group No. 6)

The C.C.I.R.

unanimously decides that the following question be studied:

Can Report No. 5 of the United States Army Signal Corps Radio Propagation Unit be considered as the most complete and reliable information available concerning atmospheric noise ?

QUESTION N° 11

Presentation of the Results of Atmospheric Radio Noise Measurements for the Requirements of Operational Services

(Study Group No. 6)

The results of measurements of atmospheric radio noise show the intensity of noise in given experimental equipment. It is necessary to transform these results in order to ascertain to what extent the noise affects various services and various types of receiving equipment used.

A preliminary answer to these questions is given by certain documents (RPU Report No 5 and PFB Document No 271). It is, however, most important for these subjects to be systematically and thoroughly examined. Our present knowledge in this field does not seem to justify the recommendation of standardised measuring methods, and further progress in this direction seems, for the present, to be within the province of scientific research. However, while awaiting further results, it seems advisable to promote activity on a more empirical basis with a view to revising and improving the above-mentioned documents.

In order to facilitate and to coordinate these studies, the C.C.I.R. is of the opinion that the problems arising from the requirements of radio operation should be clearly stated:

(a) by drawing up a list of the services the operation of which should be considered;

(b) by enumerating the characteristics of the receiving equipment, the use of which is envisaged, with a view to preparing correction tables and graphs enabling particular cases to be considered.

Consequently, the C.C.I.R.

recommends :

1. that the studies by the large Scientific Research Organisations be encouraged on the influence of atmospheric radio noise on the general operation of radiocommunication and in particular receiving equipment;

2. that more empirical work be carried out with regard to the revision of existing documents relating to these questions;

3. that the programme of these two categories of research be particularly concerned with the following services:

A. Aural Services:

(a) A1 telegraphy (24 bauds) with aural reception;

(b) A2 telegraphy modulated at 1000 c/s (24 bauds) with aural reception;

(c) A3 Double side band commercial telephony;

(d) A3 High fidelity double sideband commercial telephony;

(e) A3 Commercial telephony with reduced carrier, including 1 to 4 independent sidebands;

(f) A3 Broadcasting;

B. Telegraph Services with Automatic Recording:

(a) A1 Telegraphy (120 to 480 bauds);

(b) A2 Telegraphy, modulated at 1000 c/s (120 bauds);

(c) F1 Frequency Shift Telegraphy (120 to 480 bauds);

C. Other Services:

(a) A4 Facsimile;

(b) Hell;

(c) Baudot-Verdan;

(d) Multitone Telegraphy (S.S.B. reduced carrier);

4. that the research programme be likewise concerned with the following characteristics of receiving equipment and that the results be submitted in the form of correction tables or nomograms making it possible for each particular case to be considered, viz:

(a) antenna;

(b) band width of RF, IF, and AF Stages;

(c) time constant of automatic volume control;

(d) method of detection.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this question:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

QUESTION N° 12

Accurate Measurement of Atmospheric Radio Noise

(Study Group No 6)

The C.C.I.R.

considering :

(a) that only the accurate knowledge of atmospheric radio noise phenomena allows a rational solution of the problems arising from the existence of atmospheric radio noise in the operation of radio transmissions;

(b) that the results obtained thus far in these fields are fragmentary;

(c) that this work still constitutes a field for useful scientific research;

(d) that it is not at present possible to propose a detailed plan of studies;

(e) that it is, however, desirable to enumerate certain aspects of the problem which are of interest in the practical operation of radio transmission;

decides :

A. that the important scientific research organisations be encouraged to study in particular the following aspects of the problem:

1. atmospheric radio noise isolated from the additional influence of extra-terrestrial

and man-made noise, as well as from the internal noises of the receiver used for the measurement;

2. the separate study of solar and galactic noise in the various frequency ranges;
3. the evaluation, in at least an approximate manner, of man-made noise (in collaboration with the International Special Committee on Radio Interference);
4. the study of thermal noise in the aerials, conductors and vacuum tubes;
5. methods of noise measurement avoiding interference caused by disturbing transmissions, particularly considering the use of scheduled interruptions in standard frequency and time signal transmission;
6. the study of atmospheric noise in the range of 10 kc/s to 20 Mc/s, with particular emphasis on the band of 10 kc/s to 300 kc/s (arrival angle, polarization, rapid and slow variations);

B. that Study Group No 6 coordinate the investigations. In order that the Study Group No 6 may be fully advised on the present position, the Administrations which participate in noise measuring

work are invited to draw up a comprehensive statement of their work, summarising in particular the partial results contained in publications and stating hypotheses made and methods employed.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this question:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

QUESTION N° 13

Radio Measurements of Thunderstorm Activity.

(Study Group N° 6)

In order to develop our knowledge of the origin and propagation of atmospheric radio noise, it would be of great interest, apart from the collection of meteorological data 1), to develop radio measurements of thunderstorm activity and the location of thunderstorm centres. These measurements would have to be distinguished from those which give atmospheric radio noise intensity or which study the effect of such noise on the different radio transmission services and on the receiving equipment used, and their sole purpose would be to supply statistical information on the frequency of thunderstorms.

They should, however, be combined with more refined measurements, carried out at qualified laboratories, enabling the apparatus to be standardized, permitting the determination of the most important characteristic properties to be measured, and relating these measurements to measurements of the effect of the disturbances on radio transmissions.

Only automatic and continuous recording, conducted by a world-wide network of stations, appears to be capable of supplying the necessary amount of statistical data. Various types of equipment can be envisaged :

(a) a simple apparatus capable of being widely distributed among meteorological stations, and intended to replace the human ear for the aural observation of electric discharges;

(b) various apparatus used for counting, locating, and measuring the intensity of atmospheric noise (examples of such apparatus are given in Annex)

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1) See opinion No. 3.

Consequently, the C.C.I.R. proposes :

1. that Study Group No. 6 should examine the possibility of preparing a specification for a simple rugged apparatus, of low cost, capable of showing whether or not there have been, during a certain period, one or several electric discharges in the zone at the centre of which it is situated, and the area of which is approximately equal to that covered by the normal hearing of an observer who is not disturbed by other sounds;

2. that the study and the placing in operation of equipment permitting the counting, locating and evaluating of atmospheric noise on a range of frequencies between 10 kc/s to 20 Mc/s be continued, and that any equipment should be tested during a period sufficient for appreciation of the value of the results which it supplies, in order to provide a basis for plans for standardization to be submitted to the 6th meeting of the C.C.I.R;

3. that the large Organizations of Scientific Research be encouraged to continue their work on the detailed study of atmospheric radio noise and its effect on receiving apparatus, and also on new

experimental techniques;

4. that within the capabilities of the equipment mentioned in paragraphs 1 and 2 above, a world-wide plan of the distribution of recording stations, of the presentation of results, and of the collection of observed data should be examined;

5. that the closest possible collaboration be instituted among the members of the C.C.I.R. through the intermediary of Study Group No. 6 in order to conduct this work satisfactorily and that this collaboration could be profitably commenced by the exchange of information at present available on existing equipment and of suggestions for desirable improvements;

ANNEX

As an example of the equipment mentioned in paragraph 2 above, certain types of equipment constructed or planned in the Laboratoire National de Radioélectricité de Bagneux (Seine) are given below:

(a) narrow beam goniometer on 11 km. wave length (27 kc/s). This apparatus records the number and direction of atmospherics. Its effective range varies from 2500 to 6000 km;

(b) mean level recorders, on a range of from 24 km to 26 m wavelength (125 kc/s to 11.5 Mc/s). This apparatus counts the number of atmospherics;

(c) Adcock goniometer on short waves with photographic recording on cathode ray tube (under study).

page 148 (Question nº 13),

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they did not accept this question :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this question:

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

QUESTION No. 14

Investigation of Fading

(Study Group No 6)

The C.C.I.R.

considering :

(a) that the practical requirements of radio communication necessitate not only information on the median received field intensity of radio signals, but also data on the magnitude, distribution, and rapidity of field intensity variations;

(b) that field intensity variation phenomena involve focussing and interference effects, both by components of a single mode and between different modes, as well as variations of ionospheric absorption;

(c) that the variations of field intensity are usually divided into three types (See PFB Document No 203, Vth Meeting of C.C.I.R. Document 133):

1. short period variations, Rayleigh-distribution with time. The rapidity of this type of fading varies considerably, from very rapid "flutter fading", of rates comparable with low audio frequencies, to relatively slow fading of the order of several minutes. These rates are related to the frequency of the radio wave and are taken into account by the fading safety factor;

2. long period variations, distributed in a more normal manner. These are believed to be related to variations in ionospheric absorption or focussing and defocussing effects in the ionosphere, or both, and are taken into account by the intensity fluctuation factor;

3. regular variations with time of day, season and solar activity level, to which are added the variation due to the preceding two types of variation;

(d) that the effects of field intensity variations on radio communication involve not only the time distribution of short and long period variations, but also the rapidity of the fading with respect to the speed of transmission, the effects of equipment time-constants and, in the case of telephony, selective fading;

(e) that operational requirements necessitate not only a knowledge of intensity variations of a single signal, but also a knowledge of the variations of the ratio of useful signal intensity to interfering signal intensity or to noise intensity;

(f) that it is important to have comprehensive information on the advantage of diversity reception;

unanimously decides :

1. that theoretical studies on the distribution with time of representative statistical parameters of the field intensity be pursued.

2. that theoretical studies on the effects produced by field intensity variations on different receiving systems be pursued.

3. that experimental studies be undertaken with a view to ascertaining the mechanisms which produce the field intensity variations.

4. that empirical studies be undertaken on:

(a) the time distribution and rapidity of short period variations of field intensity;

(b) the time distribution of day-to-day variations of hourly median values of field intensity;

(c) the degree of correlation between variations of field intensities of signals, :

1. on adjacent frequencies arriving over the same path;

2. on the same frequency, from the same transmitter, and arriving at different locations.

5. that empirical studies be undertaken to evaluate the necessary protection ratio against :

(a) another fading signal, and

(b) noise;

for different qualities of service, and for different types of communication services. These studies should involve the time constants and other characteristics of the receiving equipment used, selectivity of the ear, etc.

QUESTION N° 15

Allowances for Fading

(Study Group No 6)

The C.C.I.R.

unanimously decides that the following question be studied:

What are suitable numerical values or formulae for three types of fading which may broadly be classified as:

(a) rapid variations,

(b) hourly variations,

(c) daily variations ?

Rapid variations are intended to refer to those whose duration is roughly between 10^{-4} second and several seconds.

"Hourly" and "daily" are intended to define roughly a cycle of variation during the time when a useable field exists.

(a) For rapid fading, the Rayleigh distribution of amplitudes is often assumed. Does this assumption appear to be a reasonable one ?

(b) Is 6 db as an allowance for hourly variation a reasonable value ?

(c) Is an additional allowance needed to account for daily variations ?

(d) To what extent are these values dependent upon geographical location ?

(e) To what extent are these values mutually dependent, that is, to what extent can these variations be used independently in determining acceptable signal-to-interference ratios ?

QUESTION N° 16

Bandwidth Measurement by Monitoring Stations

(Study Groups nos. 1 and 8)

The C.C.I.R.

considering :

(a) that the measurement of bandwidth as defined in the first chapter of the Radio Regulations of Atlantic City (Article I, Section IV) cannot yet be effectively carried out at a distance by the monitoring stations, but only in close proximity to the transmitter;

unanimously decides that the following question be studied:

Bandwidth Measurement Methods

In the study of this question, the work of the Study Groups set up to examine the question of frequency separation should be taken into consideration.

QUESTION No 17

Identification of Radio Stations

(Study Groups Nos 8, 9 & 13)

The C.C.I.R.

considering :

(a) that in order to carry out an efficient monitoring service of radio stations it is necessary for these stations to be identified as regularly as possible during their transmissions;

(b) that in many categories of radio services the identification procedure used at present is satisfactory to both the operating Agencies and the regulating Administrations, as is the case for single channel low speed telegraphy;

(c) that the Atlantic City Radio Regulations (Article 13, Section V, § 10) set forth requirements for transmission of radio call signs;

(d) that certain types of radio stations are exempted from the necessity of having an international call sign;

(e) that the problem of accomplishing identification of multichannel telephone and telegraph transmissions is particularly difficult without the use of costly special apparatus;

(f) that the requirement of frequently transmitting a call sign may impose a difficult and costly hardship on the operating Agencies, particularly where heavily loaded multi channel or high speed machine operation is employed;

unanimously decides that the following question be urgently studied :

The possibilities of ensuring the convenient identification of stations utilizing multiple channel, synchronized systems, high speed machine systems, the Hell system and systems for the transmission of radiophotography, or other special systems of transmission, in the most effective manner without the necessity of interrupting the transmissions of such stations, or of increasing the bandwidth of the emissions.

The increased costs which would be incurred by the recommended solutions to the monitoring and transmitting stations should be borne in mind.

QUESTION N° 18

Telegraphic Distortion

(Study Groups No 1 and 9)

The C.C.I.R.

unanimously decides :

that it is advantageous that a joint study should be made by the C.C.I.T. and the C.C.I.R. of the following question:

Establishment of a general definition of telegraphic distortion, capable of being usefully applied to the case of radiotelegraphy.

QUESTION N° 19

5-Unit Radio Teleprinter

(Study Groups nos 3 and 9)

The C.C.I.R.

considering :

(a) that the C.C.I.T. has recommended the use on international telegraph circuits, subject to certain reservations, of 5-unit apparatus employing the international telegraph alphabet No. 2 (C.C.I.T. 6th Meeting, Document no 145);

(b) that radiotelegraph circuits are required to operate under varying conditions of radio propagation, atmospheric noise and interference which introduce varying degrees of distortion;

(c) that the use of the 5-unit code is susceptible to errors which are not immediately detectable;

unanimously decides that the following question be studied :

1. The effects of varying conditions of propagation, atmospheric noise and interference on radiotelegraph circuits employing the 5-unit code in

(a) synchronous systems,

(b) start-stop systems;

2. the signal distortion that may be expected having regard to signal-noise ratio, propagation effects, type of transmission, etc.;

3. the use of special types of transmission and the possible adoption of another code on the radio circuit;

4. if another code or special type of transmission is recommended, what equipment should be used at the terminals of radio circuits to permit their interconnection with wire circuits using the 5-unit international alphabet No. 2.

QUESTION No 20

Frequency Shift Keying

(Study Groups No 1 and 9)

The C.C.I.R.

considering :

(a) that frequency shift keying is employed in radiotelegraphy on fixed services and its use may be extended to the mobile services ;

(b) that it is desirable to standardize the main operating characteristics of systems employing frequency shift keying ;

(c) that various technical factors influence the choice of operating characteristics in such systems, in particular :

1. the overlap of marking and spacing signals due to multipath propagation (in this respect a small deviation is preferable);

2. the possible advantage of frequency diversity for reception (an advantage which increases with increasing deviation);

3. the economy of bandwidth and the consequent necessity for controlling the shape of the transmitted signals ;

4. instability of frequency, which is one reason for the relatively large deviation employed in many existing equipments ;

5. the choice of receiving system, whether with separate filters or with frequency discriminator;

unanimously decides that the following question be studied:

1. Fixation of one or more standard values of deviation for the fixed and mobile services in the various frequency bands, having regard to the various factors, in particular

(a) the frequency spectrum resulting from the keying operation,

(b) the degree of frequency diversity desired,

(c) economy of bandwidth,

(d) instability of frequencies;

2. Standardization of the relative position of the marking frequency and the spacing frequency (is it desirable to utilize the upper frequency for mark and the lower frequency for space or vice versa);

3. Compilation of a standard terminology regarding the characteristics of systems employing frequency shift keying.

QUESTION N° 21

Use of 8,364 kc/s for Radio Direction Finding

(Study Group No 9)

The C.C.I.R.

considering :

(a) that the International Radio Conference of Atlantic City (1947) in item 780, of the Radio Regulations, provides that:

> "The frequency 8,364 kc/s must be used by lifeboats, liferafts and other survival craft, if they are equipped to transmit on frequencies between 4,000 and 23,000 kc/s, and if they desire to establish with stations of the maritime mobile service communications relating to search and rescue operations - see (600)."

(b) that emissions on 8,364 kc/s from aircraft in distress and from boats, rafts and other survival craft, if intercepted by suitably equipped radio direction finding stations may permit the location of the transmitting stations, even at great distances, with sufficient accuracy to contribute effectively to the organization of search and rescue operations;

(c) that long-range radio direction finding on 8,364 kc/s may thus constitute an important factor for the safety of life at sea;

(d) that land stations will, when article 34 of the Atlantic City Radio Regulations becomes effective, keep watch during their service hours on the band 8,356 to 8,372 kc/s of which the frequency 8,364 kc/s is the centre;

unanimously decides that the following question be studied :

1. What technical conditions should be laid down for radio direction finders to provide rapid, accurate bearings (particularly on the frequency 8,364 kc/s) of aircraft in flight and aircraft, ships, lifeboats, liferafts and other survival craft in distress ?

2. What, if any, special transmission procedures are required of the distressed craft ?

3. What bearing and fix accuracy can be attained by the radio direction finder technical conditions developed in 1.

QUESTION N° 22

Study of Peak Power - Mean Power Relationships

(Study Group No. 9)

The C.C.I.R.

considering :

(a) that the Atlantic City Radio Regulations, Article 1, Section IV, items 60-64, call for the use of "peak power" in specifying the power of radio transmitter, but allow the additional use of "mean power" in cases where the peak power specification is not satisfactory or adequate;

(b) that occasions may arise, where specifications for some stations are given in terms of mean power only;

(c) that at present there is no generally agreed procedure for converting mean to peak power for certain types of modulation; and

(d) that the attached Annex gives information concerning current practice in several instances.

unanimously decides that the following question should be studied:

Peak Power - Mean Power relationships.

Study Group No. 9 should examine the relationships between "peak power" and power rated otherwise for all types of modulated emissions at present in use, and prepare recommendations and, if possible, a table of conversion factors between peak power and power rated otherwise, for consideration at the next meeting of

the C.C.I.R.

ANNEX

1. Because of the difficulty of measuring or even of defining the mean power of single sideband radiotelephony transmission, the following method is used at present in rating the peak power for single sideband radiotelephony with reduced carrier:

(a) Two modulating tones, f_1 and f_2, of equal intensity are applied and varied in intensity until their cross-modulation term $(2f_1 - f_2)$ is 25 db below the level of either tone, measured in the rf output of the transmitter.

(b) The peak power rating of the transmitter is then taken as four times the rf power output, after removal of one of the two tones.

(c) Attenuation is then inserted at a measurement point in the audio frequency system until the peak power at this point is 11 db above one milliwatt. When speech is applied at this point, its level, measured on a volume indicator meter, must be 5 V.U. in order to properly load the transmitter to its peak power rating.

(d) For additional channels up to a total of three, each channel is put on at the same level (5 V.U.).

2. For double sideband telephony with full carrier, the peak power is usually rated as four times the carrier power.

3. For pulse systems such as radar, where the duty cycle is short and constant, the ratio of mean to peak power is roughly equal to the duty cycle.

4. For on-off radiotelegraphy (A1), the peak power is equal to the mean power as measured while the key is depressed.

QUESTION N° 23

High Frequency Broadcasting

Directive Antenna Systems

(Study Group No 10)

The reasons which justify the following question are given in the annex.

It will be appropriate to organise the compilation of statistical measured results from antennae of different types in various parts of the world, in respect of the signal laid down by the main beam and subsidiary lobes, and the amount of scattering in unwanted directions.

The C.C.I.R.

unanimously decides that the following question be studied:

What are the methods by which the formation of strong subsidiary important secondary lobes can be avoided, particularly when the directional antenna systems are fed asymmetrically to produce a slew of the main beam ?

ANNEX

The characteristics of directional antenna systems used in broadcasting have been very completely studied from theoretical aspects, and a number of experimental investigations have been undertaken by various bodies on the actual measured performance. 1)

With a suitably designed antenna the power radiated in unwanted directions can be reduced to a small proportion of the power radiated in the wanted direction. An aerial system with reflector having an aperture of two wavelengths should have a radiation at 25° off the main beam reduced 16 db below the main radiation field. At 40° off the main beam the radiation should be reduced to 35 db below the main radiation path. Tests have been made as to the actual reception at distant points at places which are off the main radiation beam. These show, however, that the field at such reception points is often in excess of the expected field predicted from the power radiated in the given direction.

These abnormal signal strengths presumably result from a field which is a combination of a direct radiation in the given direction, and indirect radiation due to scattering of the main

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1) "The Measured Performance of Horizontal Dipole Transmitting Arrays" by H. Page, J.I.E.E. Vol. 92, Part III, No 18, June 1945.
"Radio Engineering" by E.K. Sandeman - Chapman & Hall, page 674.
"The Empire Service Broadcasting Station at Daventry" by L.W. Hayes and B.N. MacLarty, J.I.E.E. Vol. 85, No 513, Sept. 1939.
"Aerial Characteristics" by N. Wells, J.I.E.E. Vol. 89, Part III, No 6 June 1942.
"Restricted Range Sky Wave Transmission" by J.E. Hacke Jr. and A.H. Waynick, Elec. Eng. Dept., Pennsylvania State College, P.A. U.S.A.

beam on reflection. Measurements of this phenomenon would clearly take a very considerable time, and could only be properly evaluated on a statistical basis. It appears possible, that the limitation to frequency sharing may be the scattering of the main beam of radiation.

It will, however, always be of utility to reduce the power radiated in unwanted directions and particularly in the subsidiary lobes of an antenna system.

Further study of this question is recommended, and in particular it is recommended that attention be given to the development of methods of avoiding the production of subsidiary radiation lobes under the conditions when a directional antenna is assymmetrically fed in order to produce a slew of the main lobe of radiation.

QUESTION N° 24

Single Side Band Sound Broadcasting in the L.F., M.F. and H.F. Bands:

(Study group N° 10)

The reasons which justify the following question are given in Annex.

The C.C.I.R.

decides that the following question be studied:

A. Receivers

1. Is it possible to modify, at a reasonable cost and in a practicable manner, receivers of types, now in general use by the public, for the reception of

(a) single side-band with reduced carrier,

(b) one full side-band, full carrier and vestigial second side-band,

(c) single side-band with full carrier ?

2. Would the performance of unmodified receivers be satisfactory for the reception of

(a) single side-band with full carrier and with reduced spacings between the carrier frequencies,

(b) single side-band with full carrier with existing spacings of carrier frequencies and with an increased audio-frequency band transmitted ?

3. Would a receiver modified in accordance with paragraph 1. be also capable of receiving normal double side-band transmissions in addition to single-band transmissions ?

4. Would it be possible to construct a receiver for general public use, at a reasonable cost, for the reception of

(a) single side-band with fully suppressed carrier,

(b) single side-band with reduced carrier,

(c) single side-band with full carrier,

(d) single side-band with full carrier and vestigial second side-band ?

5. Would a receiver designed specially for single side-band reception be also suitable for the reception of normal double side-band transmissions ? If so, would it give any improvement in performance on such double side-band reception ?

6. Would any difficulties be experienced due to the radiation of a locally supplied carrier in a single side-band receiver ?

7. What is the order of preference of the types of transmission listed in question 4 above with relation to

(a) cost of receiver,

(b) fidelity obtained,

(c) improvement in signal to interference ratio,

(d) saving in spectrum space ?

B. Transmitters

1. Should the side-band transmitted be higher or lower in frequency than the carrier frequency ?

2. Should the unwanted side-band be completely or partially suppressed ?

3. Should the carrier-wave be transmitted in full or be partly or completely suppressed ?

4. What is the desirable audio-band to be transmitted ?

5. What is the desirable minimum carrier spacing having regard to the desirable audio-band ?

6. If a vestigial side-band is also transmitted, what should be the rate of attenuation of this side-band ?

ANNEX

Reasons for Use of Single Side-band in Sound Broadcasting.

Some possible justifications for changing the system of sound broadcasting from double side-band to single side-band are as follows:

1. It might allow the possibility of either more channels in the existing bands or the same number of channels in the bands with a wider audio-band in each channel.

2. It should permit improved quality of reception, particularly with regard to the harmful effect accompanying indirect and multipath propagation on high frequency services.

3. It is possible that the use of single side-band transmission would give an improvement in the over all performance both of a network of synchronized stations and of stations working on a common channel.

4. It would possibly give an improvement in the power economy of transmitters, particularly if it were possible to operate with the carrier suppressed.

5. It would possibly give an increase in the received signal intensity, as it would permit more power to be put into the side-band actually transmitted.

6. It would possibly give an improvement in the fading-free area for medium frequency broadcasting.

QUESTION N° 25

Single Side Band Broadcasting of Television

(Study Group No 11)

The reasons which justify the following question are given in annex.

The C.C.I.R. decides that the following question be studied

A. Receivers

1. Is it possible to produce at a reasonable cost a domestic type television receiver that would give adequate performance on a single sideband transmission ? Would the tuning of such a receiver compare in ease with that of a double sideband receiver ?

2. Would it be possible to use existing receivers designed for reception of double sideband transmissions on single sideband transmissions or could they be modified at reasonable cost ?

3. Could receivers, specially designed for single sideband be used also for the reception of double sideband transmissions ?

4. Would the receivers evolved in accordance with paragraph 1 above have advantages over a double

sideband receiver as regards reduced interference (spurious and harmonic radiation, unwanted signals present in the ether, radiation from other receivers, ignition interference and radiation from industrial, scientific and medical equipment) ?

B. Transmitters

1. Should the transmitted sideband be higher or lower in frequency than the carrier frequency ?

2. What should be the relative positions of the sound and vision carriers ?

3. Should the unwanted sideband be completely or partially suppressed, and what should be its rate of attenuation ?

4. Should the carrier wave be suppressed wholly or in part ?

5. What would be the saving in channel space by the use of single sideband for various possible values of vision bandwidth transmitted ?

ANNEX

The following points with regard to television transmission and reception relate only to the vision signal and it is assumed that the characteristics of the sound signal are not part of this question.

Some reasons for the possible use of single sideband transmission for television purposes are:

1. It may permit either more channels to be accommodated in existing bands or may permit a wider bandwidth to be used with the same number of channels.

2. It may permit an improved signal to be obtained at the output of the receiver.

3. It may permit improved results to be obtained, if television stations are operated in synchronized groups and of stations working on a common channel.

4. By reducing the over all bandwidth to be transmitted, it may facilitate the design of the transmitting and receiving equipment.

5. It might allow a simplification of the receiver in cases, where the vision carrier is used to beat with the sound carrier and produce a sound signal intermediate frequency.

6. It might facilitate the later adoption of higher definition standards and possibly enable existing designs of receivers to be more readily adapted for use on such a new system as well as on the existing system. It might also facilitate the design of new receivers, which could receive such new systems and existing systems.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this question:

Poland, Ukrainian Soviet Socialist Republic.

QUESTION N° 26

Disturbances in Television Receivers Resulting from Harmonics and other Non-essential Radiations of Radio Transmitters[1)]

(Study Group N° 11)

Reasons

As indicated in Recommendation No. 27 the C.C.I.R. relies on the C.I.S.P.R. for the study of parasitic interference other than those produced by transmitters. But since the study of the latter appears to fall outside the competence of the C.I.S.P.R. it has been deemed necessary to set a new question.

1. Can interference be produced in television receivers by the harmonics and other non-essential radiations of radio transmitters, when the power of these non-essential radiations remains within the permissible limits given in the Atlantic City Radio Regulations ?

2. If the answer to 1. is in the affirmative:

(a) In which frequency bands should the prescriptions of the Atlantic City Radio Regulations relative to these harmonics and other non-essential radiations be modified ?

(b) What new permissible limits are to be prescribed in these frequency bands concerning maximum acceptable power for harmonics and other non-essential radiations by radio transmitters ?

QUESTION N° 27

Maximum Power for Short Distance High Frequency Broadcasting in the Tropical Zones

(Study Group No 12)

The considerations in formulating this question are given in the annex.

The C.C.I.R.,

considering :

(a) that a short distance high frequency broadcasting service is an indirect ray service in which the incident ray meets the reflecting layer at a considerable angle to the horizontal and there is no appreciable skip distance between the transmitter and the service area;

(b) that the outer limit of a short distance service is considered here as being 800 km;

decides that the following question be studied:

1. What is the upper power limit for short distance high frequency broadcasting on frequencies up to and including 6.2 Mc/s ?

2. For those occasions when the use of a frequency higher than 6.2 Mc/s in the H.F. band is appropriate, what is the upper limit of power ?

3. Where the service area to be covered, the

propagation conditions, noise and other pertinent factors permit, should a power lower than those specified in paragraphs 1 and 2 be used ?

4. For a short distance high frequency broadcasting service, what attention should be paid to the antenna system to increase its radiation within the angle comprised between the vertical and the limit direction desired, corresponding to the service area, and to reduce radiation outside the service area ?

ANNEX

Assumption

As a basic assumption a short distance high frequency broadcasting service is defined as an indirect ray service in which the incident ray meets the reflecting layer at a considerable angle to the horizontal, and there is no appreciable skip-distance between the transmitter and the service area. The outer limit of a short distance service is here defined as a maximum of 800 km.

Short distance high frequency broadcasting services are of principal use in those areas which cannot be adequately covered by medium and low frequency services, and their use has been considered as limited to tropical and subtropical areas. Consideration has been given to a limited number of cases which are typical of the range of conditions to be met in the areas concerned over the year and the sunspot cycle. The conditions on the equator and latitude 45° N have been studied. For the purpose of the present study the results obtained for 45° N can be applied to 45° S if allowance is made for the interchange of seasons; conditions for intermediate latitudes can be obtained by interpolation.

Discussion

Recommendation A3 (b) of the International High Frequency Broadcasting Conference states: "As far as possible for average propagation and noise conditions, the level of the wanted signal should be 40 db above the atmospheric noise level", and calculations have been made to discover the transmitted power necessary to obtain this signal-to-noise ratio as well as ratios of 30 db and 20 db, which latter ratio may be regarded as the minimum for a broadcast service.

The curves referred to below are attached, and have been

plotted for frequencies likely to be of use for the service required at various periods, and are shown as follows:

Fig. 1	45°N, Sunspot Minimum,	3, 6 and 12 Mc/s
Fig. 2	45°N, Sunspot Median,	3, 6 and 12 Mc/s
Fig. 3	45°N, Sunspot Maximum,	3, 6 and 12 Mc/s
Fig. 4	Equator, Sunspot Minimum,	3, 6 and 12 Mc/s
Fig. 5	Equator, Sunspot Median,	3, 6 and 12 Mc/s
Fig. 6	Equator, Sunspot Maximum,	3, 6 and 12 Mc/s
Fig. 7	Equator, Sunspot Minimum, Median and Maximum	9.5 Mc/s

These curves show the radiated power required to give a 20 db signal-to-noise ratio. The noise grades are taken from the joint U.K. - U.S. data published in the I.R.P.L. Handbook dated November 1943, and are representative of the areas in question. An increase in power above the values given by the curves will result in a corresponding increase in signal-to-noise ratio, although not always to an increase in the quality of the received signal itself.

More recent information from both U.K. and U.S.A. sources, indicates that the noise values assumed in this analysis are in many cases from 10 to 20 db higher than is experienced in practice, and the actual signal-to-noise ratio will be improved by this amount. The conclusions drawn from the analysis are therefore conservative.

The solid lines on the curves show the power required for the above performance at any particular time. The broken line and an arrow on the curves indicate that the frequency is no longer useful outside the given portion of the curve.

Where the radiated power required is very great or very small the calculated values have not been plotted, but have been indicated by horizontal lines drawn at the extreme top or bottom of the graphs.

It appears that if only one frequency is used at a time, with 10 kW radiated power, the signal-to-noise ratio will occasionally

fall below 20 db; it should however be higher than 20 db for a large proportion of the time. The percentages of time for which signal-to-noise ratios equal to, or better than, 20 db, 30 db and 40 db should be achieved at all distances up to 800 km range, using only one frequency at a time, are set out in the table below. It will be seen that the minimum signal-to-noise ratio should be achieved at all times on the equator, while at 45°N it is only during the mid-summer period that 100 % coverage at 20 db signal-to-noise ratio fails, and then only at the extreme range, and for only 5 - 8 % of the time.

Signal-to-noise Ratio	SUNSPOT MAXIMUM			SUNSPOT MEDIAN			SUNSPOT MINIMUM		
	At least 20 db	At least 30 db	At least 40 db	At least 20 db	At least 30 db	At least 40 db	At least 20 db	At least 30 db	At least 40 db
EQUATOR:									
June	100	100	87	100	100	63	100	75	50
Equinox	100	100	100	100	100	100	100	92	57
December	100	100	87	100	95	63	100	80	50
45°N									
June	95	57	42	100	95	42	92	87	17
Equinox	100	100	100	100	100	50	100	100	71
December	100	95	75	100	100	80	100	100	50

These tables show the percentage of time that the signal-to-noise ratio equals or exceeds the figures quoted, assuming, for the reasons indicated below, a power of 10 kW on frequencies of 6 Mc/s and below, and 1 kW on higher frequencies, and also the use of the best frequency of those indicated on the appropriate charts, i.e. the best frequency from 3.3 Mc/s, 6 Mc/s, 9.6 Mc/s and 11.8 Mc/s for the Equator, and the best frequency of 3.3 Mc/s, 6 Mc/s and

11.8 Mc/s for 45°N. (1)

Therefore, it would appear that for frequencies up to and including 6 Mc/s there might be no need to use a higher power than 10 kW, and in many cases considerably less power would be adequate.

Making the same assumption regarding transmitter powers, it can be seen from the curves that it should be possible to maintain a signal-to-noise ratio of 30 db or better at all times. If use is occasionally made of two frequencies simultaneously, a signal-to-noise ratio of 40 db should be maintained most of the time under these conditions.

At times when propagation conditions are such as to favour the use of a frequency in one of the higher bands, for example, 9.6 Mc/s or 11.8 Mc/s, the reduced absorption at these frequencies results in a considerable reduction in the transmitted power necessary to achieve the same resultant signal-to-noise ratio at the reception point.

From an inspection of the curves it will be seen that a power of considerably less than 1 kW on the higher frequencies will give results comparable with those on 10 kW at the lower frequencies. Consequently it would seem unnecessary to use a power in excess of 1 kW on the higher frequency bands, and in many cases, considerably less power might give a satisfactory signal-to-noise ratio. In considering the design of such short distance broadcasting services, it would appear that particular attention should be given to the design of the antenna so as to confine the greater part of the radiation within such angles as to bring the reflected field down to earth within the limits of the service area. This is of importance from the following

(1) The figures indicated correspond to the least favourable distance within the 800 km range, and are consequently very conservative; for other distances, the signal-noise ratio will in fact be higher.

points of view:

(a) obtaining the maximum efficiency for the local service;

(b) of causing minimum interference to all the users. This is of particular importance in the case of the higher frequencies;

(c) permitting the simultaneous use of a frequency by the number of stations.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this question:

Poland, Ukrainian Soviet Socialist Republic.

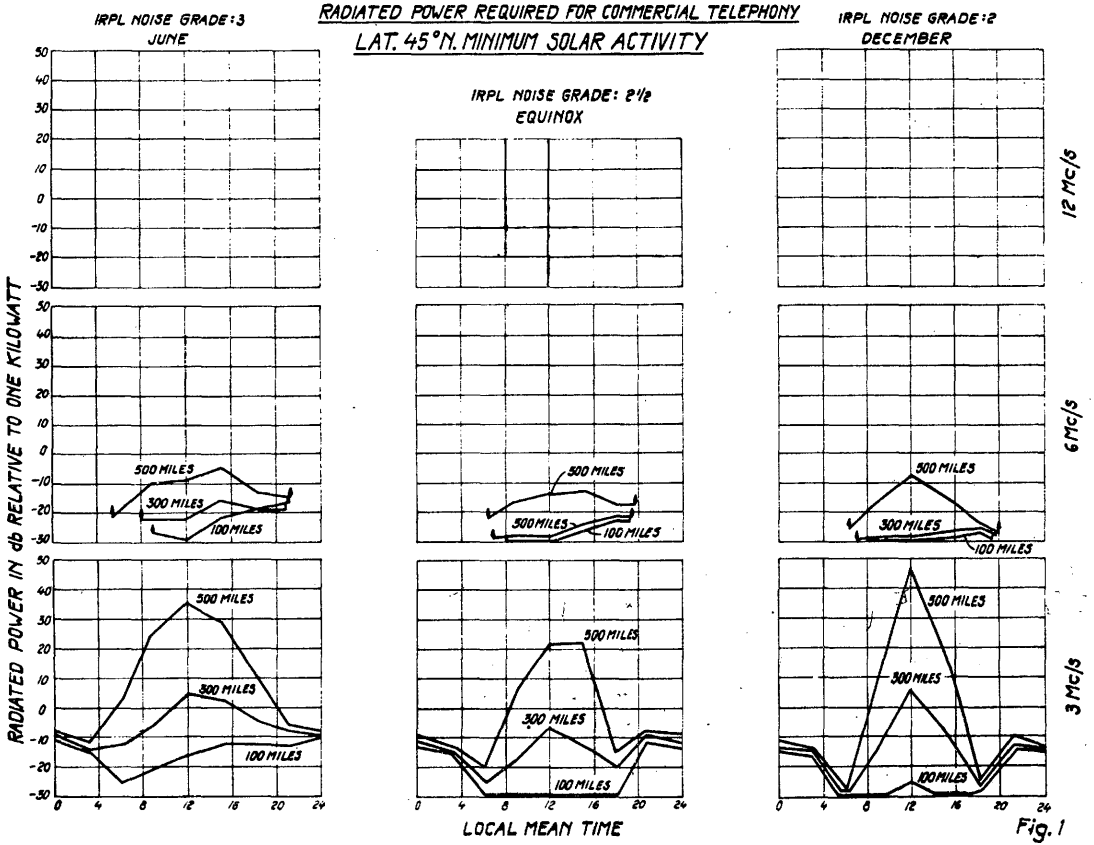
RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY
LAT. 45°N. MINIMUM SOLAR ACTIVITY
IRPL NOISE GRADE:3
JUNE
IRPL NOISE GRADE: 2½
EQUINOX
IRPL NOISE GRADE:2
DECEMBER
12 Mc/s
6 Mc/s
3 Mc/s
500 MILES
300 MILES
100 MILES
RADIATED POWER IN db RELATIVE TO ONE KILOWATT
LOCAL MEAN TIME

Fig. 1

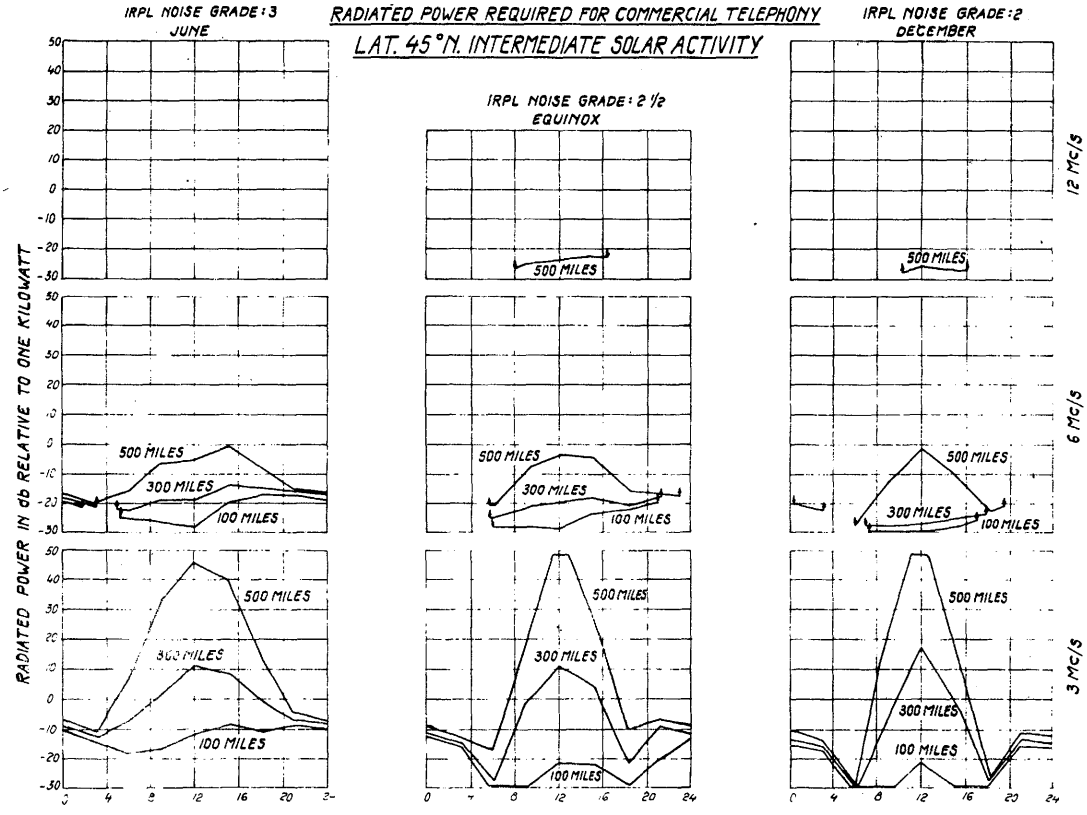
RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY
LAT. 45°N. INTERMEDIATE SOLAR ACTIVITY
IRPL NOISE GRADE: 3
JUNE
IRPL NOISE GRADE: 2 1/2
EQUINOX
IRPL NOISE GRADE: 2
DECEMBER
12 Mc/s
6 Mc/s
3 Mc/s
500 MILES
300 MILES
100 MILES
RADIATED POWER IN db RELATIVE TO ONE KILOWATT
LOCAL MEAN TIME

Fig. 2

RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY

LAT. 45°N. MAXIMUM SOLAR ACTIVITY

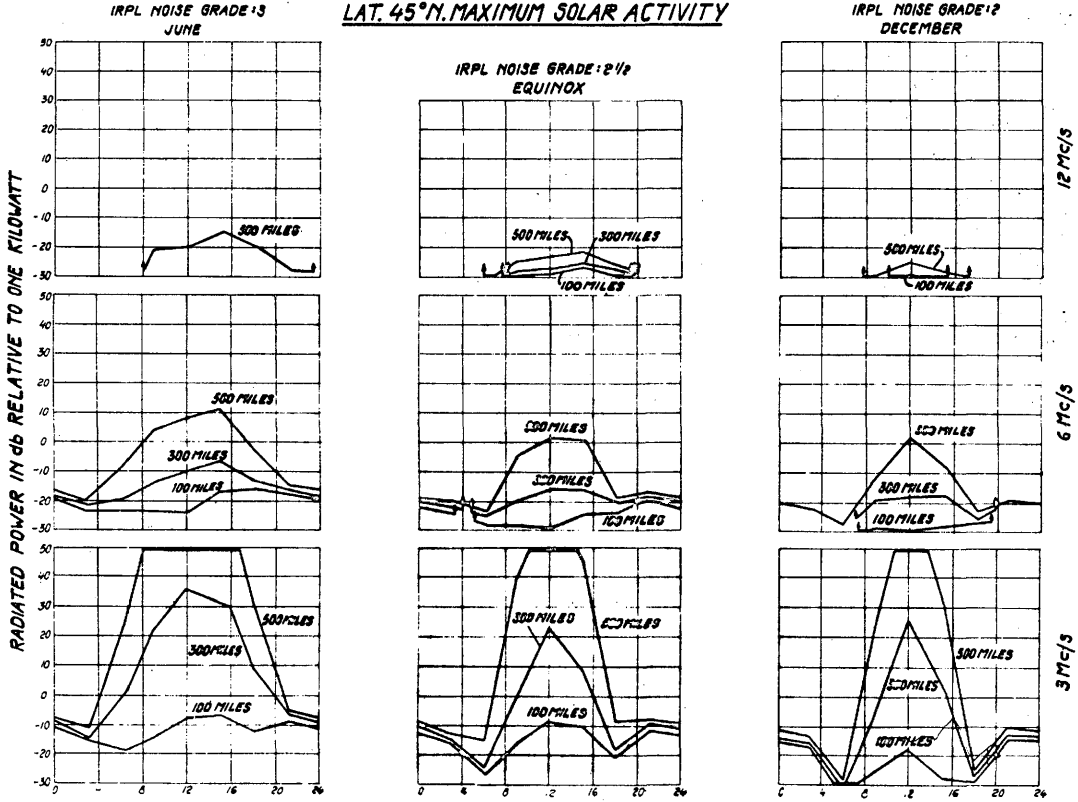

Fig. 3

RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY

EQUATOR. MINIMUM SOLAR ACTIVITY

IRPL NOISE GRADE: 4 (ALL SEASONS)

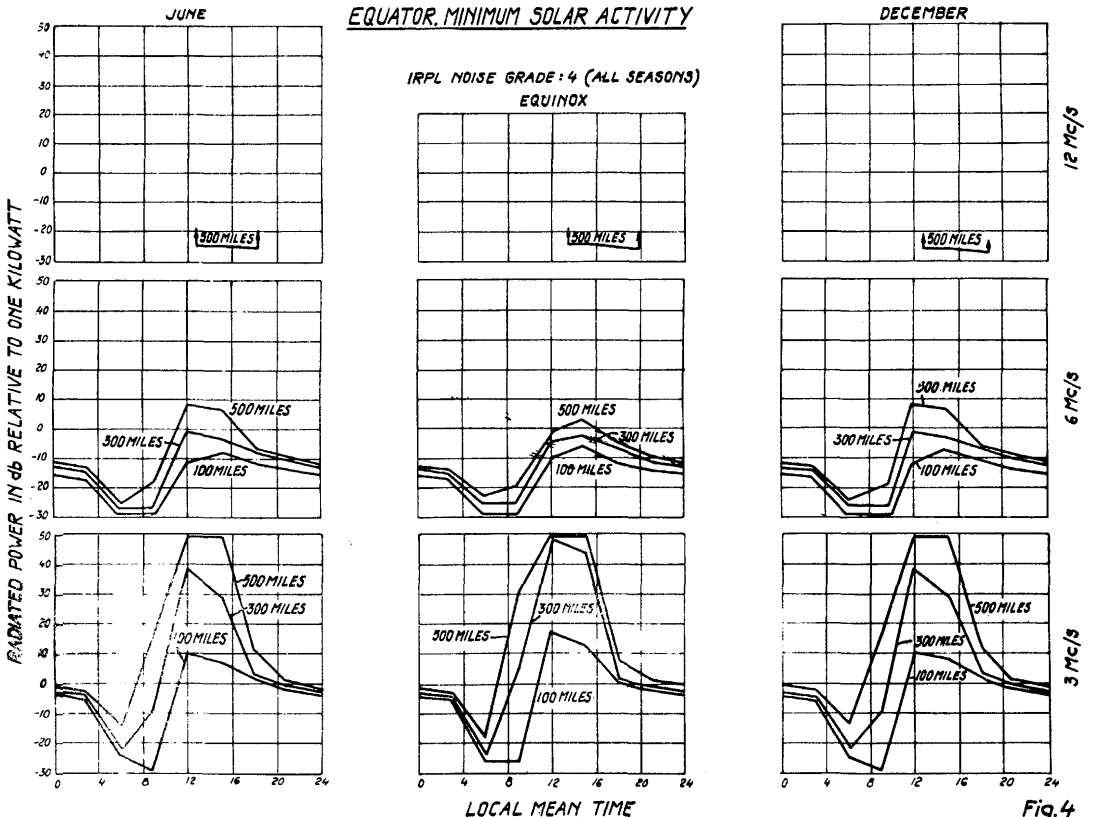

Fig.4

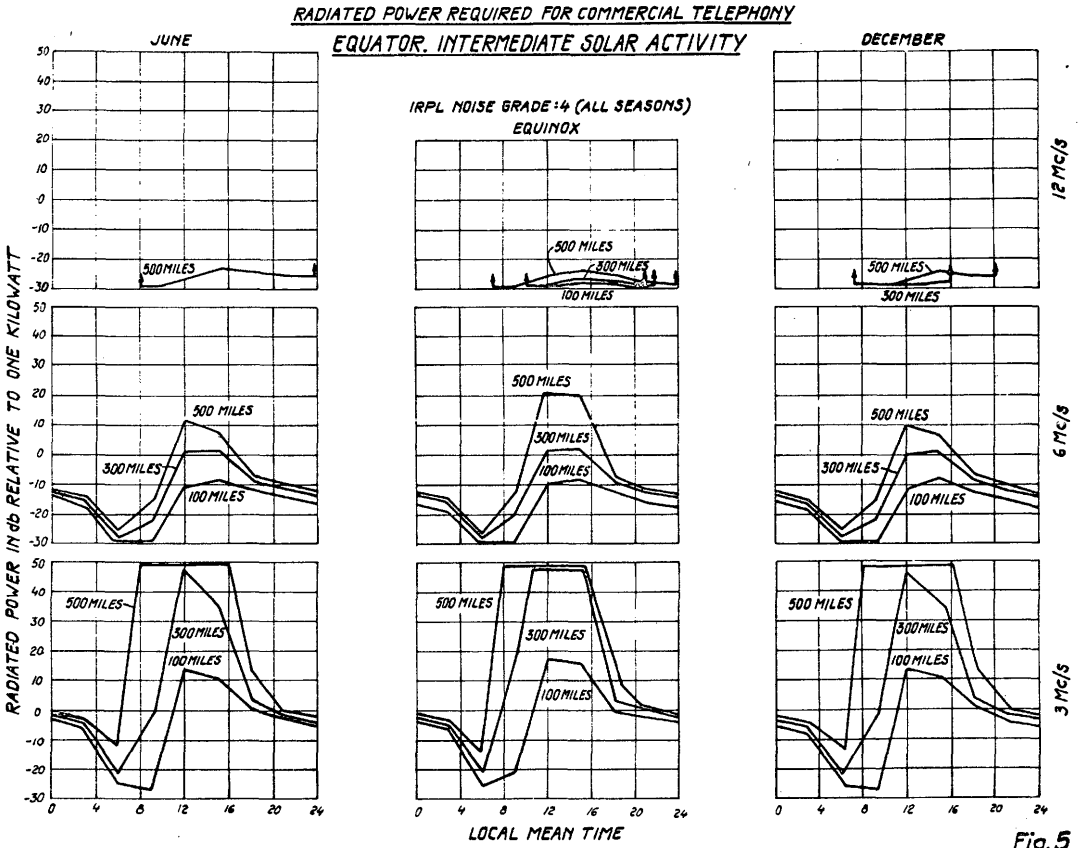
RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY
EQUATOR. INTERMEDIATE SOLAR ACTIVITY
IRPL NOISE GRADE: 4 (ALL SEASONS)
JUNE
EQUINOX
DECEMBER
12 Mc/s
6 Mc/s
3 Mc/s
500 MILES
300 MILES
100 MILES
RADIATED POWER IN db RELATIVE TO ONE KILOWATT
LOCAL MEAN TIME
50
40
30
20
10
0
-10
-20
-30
0
4
8
12
16
20
24

Fig. 5

RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY
EQUATOR. MAXIMUM SOLAR ACTIVITY

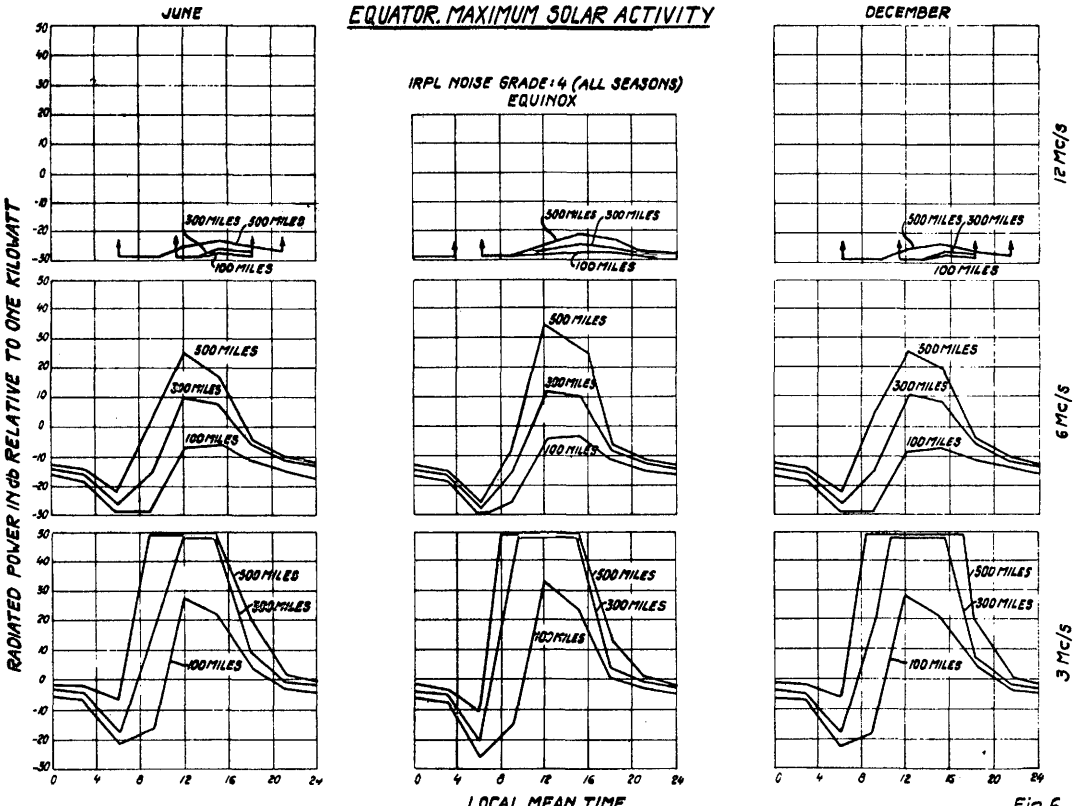

Fig. 6

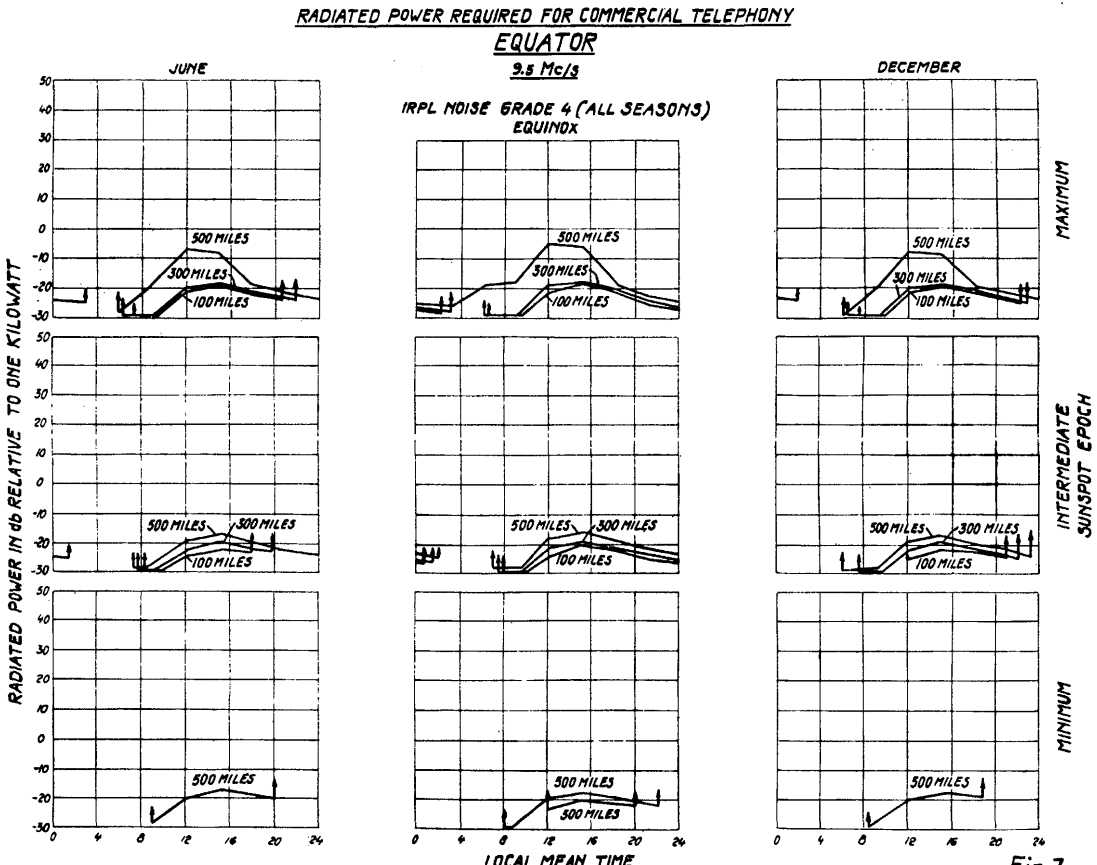
RADIATED POWER REQUIRED FOR COMMERCIAL TELEPHONY
EQUATOR
9.5 Mc/s
IRPL NOISE GRADE 4 (ALL SEASONS)
EQUINOX
JUNE
DECEMBER
MAXIMUM
INTERMEDIATE SUNSPOT EPOCH
MINIMUM
RADIATED POWER IN db RELATIVE TO ONE KILOWATT
LOCAL MEAN TIME
500 MILES
300 MILES
100 MILES
50
40
30
20
10
0
-10
-20
-30
0
4
8
12
16
20
24

Fig. 7

QUESTION N° 28.

Addition to Appendix 9 of the Radio Regulations.

(Study Group N° 13)

Addition to Appendix 9 of the Radio Regulations (Atlantic City, 1947) of

1 . the FRAME Code

2 . the RAFISBENQO or the RISAFMONE Code.

QUESTIONS RAISED BY THE C.C.I.F.

AND

CONCERNING RADIO COMMUNICATIONS.

QUESTION N° 29

(Question N° 33 of Reporters Committee N° 3 of the C.C.I.F.)

(Page 271 of the Yellow Book of the C.C.I.F.)

In view of the development of telephonic systems connecting the various continents, would it not be advisable to set up standards for inter-continental connections ?

If so, the following points should be defined :

(a) What are the admissible limits for the variation of the equivalent of the international circuit, in terms of frequency, for inter-continental connections based on an effective transmission of the frequency band from 300 to 3,400 c/s.

(b) What is the admissible maximum psophometric voltage at the end of an inter-continental connection, and how should interfering noises be distributed between the different international sections of a circuit crossing several continents ?

(c) What are the admissible limits for the variation of the equivalent of the international circuit in terms of time ?

The study of this question is assigned to Study Group N° 1 of the C.C.I.R.

QUESTION N° 30

(Question N° 1 of Reporters Committee N° 5 of the C.C.I.F.)

(Page 333 of the Yellow Book of the C.C.I.F.)

What are the principles of the devices used by Administrations and Private Enterprises for achieving secrecy of radiotelephonic conversations ? What are the characteristics of these devices, (distortions produced by the different types of secrecy device, constancy of intermediate frequencies, etc.) and what is their location in relation to the other units of the circuit ?

The study of this question is assigned to Study Group N° 9 of the C.C.I.R.

QUESTION N° 31

(Question N° 2 of the Reporters Committee N° 5 of the C.C.I.F.)

(Page 336 of the Yellow Book of the C.C.I.F.)

a) What classification should be adopted for the different types of feed-back suppressors and what terminology should be applied to this subject ?

b) What are the essential characteristics of feed-back suppressors used by the different Administrations and Private Enterprises on their radio telephone circuits ?

The study of this question is assigned to Study Group N° 9 of the C.C.I.R.

QUESTION N° 32

(Question N° 3 of Reporters Committee N° 5 of the C.C.I.F.)

(Page 340 of the Yellow Book of the C.C.I.F.)

What are the essential characteristics of the devices controlled by voice currents and acting on the carrier wave in radio-telephonic stations on board ships, and what are the essential characteristics of the devices installed in the corresponding coastal stations and which are controlled directly by the carrier wave ? What conditions do these devices have to fulfil, particularly with regard to "operation time" and "return to zero time".

The study of this question is assigned to Study Group N° 9 of the C.C.I.R.

QUESTION N° 33

(Question N° 4 of Reporters Committee N° 5 of the C.C.I.F.)

(Page 342 of the Yellow Book of the C.C.I.F.)

With what conditions must telephonic connections between mobile radiotelephone stations (for instance automobiles, aircraft and ships) and international telephone lines comply ?

Note - It will probably be necessary to study the question of selective signalling from fixed stations to mobile radio telephone stations.

The study of this question is assigned to Study Group N° 9 of the C.C.I.R.

STUDY GROUPS

OF THE

C.C.I.R.

S T U D Y G R O U P S O F T H E C.C.I.R.

Constitution of New Study Groups asked by the Fifth Plenary Assembly of the C.C.I.R.(Stockholm 1948) to deal with questions formulated by that Assembly.

The Plenary Assembly of the C.C.I.R. decides to set up the thirteen Study Groups listed hereafter:

Study Group No 1 (Radio Transmitters)

This Study Group will deal with the following recommendation and questions:

Recommendation No 3

Questions Nos 1, 16, 18, 20 and 29

Study Group No 2 (Radio Receivers)

This Study Group will deal with the following recommendations and question :

Recommendations Nos 2 and 4

Question No 2.

Study Group No 3 (Complete Radio Systems employed by the different Services)

This Study Group will deal with the following recommendation and questions:

Recommendation No 1 and 17

Questions Nos 3, 4 and 19

Study Group No 4 (Ground Wave Propagation)

This Study Group will deal with the following recommendations and questions:

Recommendations Nos 11, 12, 14 and 17

Questions Nos 5, 6, 7 and 8.

Study Group No 5 (Tropospheric Propagation)

This Study Group will deal with the following recommendations and questions :

Recommendations Nos 11, 12, 14 and 15

Questions Nos 7, 8 and 9.

Study Group No 6 (Ionospheric Propagation)

This Study Group will deal with the following recommendations and questions:

Recommendations Nos 5, 6, 8, 9, 10, 11, 12, 14, 17 and 21

Questions Nos 5, 7, 8, 9, 10, 11, 12, 13, 14 and 15.

Study Group No 7 (Radio Time Signals and Standard Frequencies)

This Study Group will deal with recommendation No 18.

Study Group No 8 (Monitoring)

This Study Group will deal with the following recommendation and questions:

Recommendation No 21

Questions Nos 16 and 17.

Study Group No 9 (General Technical Questions)

This Study Group will deal with the following recommendations and questions :

Recommendations Nos 24 and 25

Questions Nos 17, 18, 19, 20, 21, 22, 30, 31, 32 and 33.

Study Group No 10 (Broadcasting including Questions relating to Single Sideband)

This Study Group will deal with the following questions:

Questions Nos 23 and 24

Study Group No 11 (Television Including Questions relating to Single Sideband)

This Study Group will deal with the following recommendation and questions:

Recommendation No 29

Questions Nos 25 and 26.

Study Group No 12 (Tropical Broadcasting)

This Study Group will deal with the following questions:

Questions Nos 4 and 27

Study Group No 13 (Operation Questions Depending Principally on Technical Considerations)

This Study Group will deal with the following questions:

Questions Nos 17 and 28.

O P I N I O N
E X P R E S S E D B Y T H E
C O M M I T T E E

OPINION No 1

to be submitted to the Administrative Council of the I.T.U.

Publication of the Documents of the 5th Meeting of the Plenary Assembly of the C.C.I.R. in Stockholm (1948)

Distribution of the Preparatory Documents of the 6th Meeting of the Plenary Assembly of the C.C.I.R.

The C.C.I.R.

considering :

(a) that it is essential for the efficacy of the studies carried on by the C.C.I.R. with regard to the present state of development of radio-communications technique:

1. to assemble a documentation in all fields of radio-communications with the assistance of the greatest possible number of members of the C.C.I.R.;

2. to establish a sequence between studies already carried out and those to come;

(b) that one of the means of meeting these two conditions is the publication and distribution, to the greatest possible extent, of the work of the Plenary Assembly of the C.C.I.R., the meetings of which provide the most qualified delegates with an opportunity of communicating and discussing the latest views on problems of current importance in the radio field;

unanimously expresses the opinion :

A. that as far as the publication of the documents of the 5th meeting of the Plenary Assembly of the C.C.I.R. is concerned, it would be advisable to make the following arrangements:

1. to publish, in one volume constituting a service document of the I.T.U. the documents enumerated below:

   (a) the Recommendations made by the Assembly; in the case when a recommendation is not unanimously adopted, mention will be made at the request of the delegations having voted against it, or of any reservation made.

   (b) the questions submitted by the Assembly to the new study groups;

2. to publish, in one volume constituting a document of the C.C.I.R., the documents listed below:

   (a) all proposals submitted to the Assembly for examination, before the opening, or in the course of the meeting, mentioning the date of their publication;

(b) the minutes of all plenary meetings of the Assembly with their Annexes (particularly the Rules of Procedure);

3. The reproduction included in these two collections will be made by the most economical method, ensuring their clear legibility (especially with regard to the formulas and diagrams) and their preservation;

4. The Secretary general shall dispatch one mimeographed copy of all documents, distributed during the Assembly:

(a) to all Members and Associate Members of the Union;

(b) to recognised private operating agencies and to international organisations having attended the 5th Plenary Assembly of the C.C.I.R. in Stockholm (1948);

B. That, with respect to the preparatory documents pertaining to the next meeting of the Plenary Assembly of the C.C.I.R., it is advisable to make the following arrangements:

1. in order to avoid a repetition of a delay such as has occurred when sending the preparatory documents for the 5th Plenary Assembly at Stockholm and in order to take into account postal delays,

the preparatory documents should be dispatched in sufficient time for them to be received by the addressees at least one month before the date of the opening of the Plenary Session of the 6th Plenary Assembly of the C.C.I.R.;

2. the documents enumerated below shall be considered and distributed as preparatory documents:

(a) all replies from members of the C.C.I.R. to the questionnaires sent to them;

(b) the technical correspondence exchanged between the chairmen and the Reporters excluding despatch notes and despatch letters;

(c) the general reports issued by the chairmen of the Study Groups with any possible annexes and supplements;

3. these documents shall be reproduced by the most economical method likely to ensure a high degree of legibility (particularly in the case of formulas and diagrams) and of preservation, at the same time permitting easy consultation.

OPINION No 2

Meteorological Information on the World Distribution of Thunderstorms

The C.C.I.R.

considering :

(a) that knowledge of the characteristics and the origin of atmospheric radio noise, although essential for the most effective operation of radio circuits, is still very insufficient and the subject requires much further study;

(b) that measurements of atmospheric radio noise alone can only separate with difficulty the two factors of the phenomena, i.e., the production of these noises in the various thunderstorm centres of the world and their propagation to the point of reception;

(c) that it would be of great interest when analysing atmospheric radio noise observations, to have available sufficiently extensive and accurate data on each of the factors mentioned and, in particular, on the production of noise in thunderstorm centres;

(d) that the information at present available (Brooks maps revised in 1943), although of considerable value, should be improved, and for this reason experimental data are needed from numerous observing stations, over a long period and effected in a manner more accurate and also more adequate to the requirement expressed above;

(e) that the collection of these data comes within the competence of meteorological organisations;

(f) that the addition of information collected by radio organizations should be of great advantage to meteorology by

bringing to light possible correlations between thunderstorm activity and solar phenomena;

expresses the opinion

1. that each Administration, member of the C.C.I.R., should take the necessary steps, through its National Meteorological Office, to obtain the desired information concerning thunderstorm activity;

2. that the Administrative Council of the Union should draw the attention of the International Meteorological Organization to the advantages of intensifying the collection of meteorological information concerning thunderstorm centres of the world.

ANNEX

1. It is not only necessary to know the number of thunderstorm days, but also the intensity of thunderstorms on those days, independently of the quantity of rain fallen.

In the first stage, it would seem possible to record the number of peals of thunder noted at each meteorological station (or at least the presence or absence of thunderclaps during the period considered). It seems preferable to take into account thunderclaps rather than visible lightning, since the visibility of the latter varies considerably by day and by night.

At a later stage it might be possible to use indicators, such as, for example, simple, strongly built counters, which are inexpensive and which could be used on a large scale. The attention of Study Group No 6 of the C.C.I.R. is drawn to the desirability of designing this equipment.

Finally it may be possible to employ other processes which could give a measurement of the frequency of occurrence and later of the intensity of electric storms.

2. This information should be analyzed and presented in the form of world maps, giving, for each region of the world, the probability of storms per unit of area.

3. For the needs of radio operation, these world maps should be prepared :

for three-hour periods of the day;

for the meteorological seasons of the year (for instance the months December - January -February, and March - April - May, etc.);

in addition, by comparing the results for various years, it could be determined whether a correlation existed between the frequency of occurrence of thunderstorms and solar activity.

replace the printed text by the following statement :

Referring to the infringements of chapter 13, paragraph 3, of Atlantic City General Regulations, committed in the course of preparation for and during the conduct of the Fifth meeting of the C. C. I. R., the following countries declared that they did not accept this opinion :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

4. Appropriate coordination between Study Group No. 6 of the C.C.I.R. and the I.M.O. is desirable in devising the measurement system and the method of presentation.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they did not accept this opinion :

Albania (Popular Republic of), Bielorussian Soviet Socialist Republic, Bulgaria (Popular Republic of), Hungary, Roumania (Popular Roumanian Republic), Czechoslovakia, Union of Soviet Socialist Republics.

Referring to Chapter 13, paragraph 3 of Atlantic City General Regulations, the following countries declared that they wished to reserve their opinion with regard to this opinion :

Poland, People's Federal Republic of Yugoslavia, Ukrainian Soviet Socialist Republic.
