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Spectrum Management and Telecommunications

Broadcasting Procedures and Rules

Part 2: Application Procedures and Rules for AM Broadcasting Undertakings

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Canada

Contents

Section A: International Agreements

A-1. AM broadcasting assignments in the 535-1605 and 1605-1705 kHz bands in Canada are made in accordance with the Regional Agreements for the Medium Frequency Broadcasting Service in Region 2 (RAMFBS-R2 and Rio[1] 1988), and the Agreements between the Government of Canada and the Government of the United States of America relating to the AM Broadcasting Service in the Medium Frequency Band (Canada/USA Agreements, 1984 and 1990)[2]. These are international agreements which govern the common use of the broadcasting band in the Region so that each country within the Region may make effective use of the band with minimum of interference between broadcasting stations. The governing principles are reflected into technical criteria which have to be followed to avoid excessive interference. While the agreements are in themselves international documents, they are implemented in Canada for domestic use, together with additional domestic requirements, through Industry Canada's Broadcast Procedures and Rules.

A-2. AM broadcasting assignments in the 525-535 kHz band in Canada are made in accordance with the *Radio Regulations* of the International Telecommunication Union. Protection to other broadcasting assignments is based on the technical criteria of the Canada/USA Agreement, 1984. Protection to non-broadcasting assignments is assured by case-by-case coordination with the operator of a Canadian assignment that may be affected (usually the Department of National Defence or the Coast Guard) or with the National Telecommunications and Information Administration (NTIA) in the United States. Broadcasting stations in this band are limited to 1 kW power day and 250 watts night.

Section B: Preparation of Technical Submissions Required with the Applications for AM Broadcasting Stations in the 525-1705 kHz Band

B-1. Application Requirements and Definitions

An application to the Department for a broadcasting certificate shall be accompanied by an application to the Canadian Radio-television and Telecommunications Commission (CRTC) for a broadcasting licence, unless the application is exempted from CRTC licensing requirements. The two applications shall be filed simultaneously.

Although the CRTC has established criteria to exempt certain categories of AM broadcasting from its licensing requirements, Industry Canada, because of spectrum management needs, maintains its requirements for the submission of technical applications.

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[1] Final Acts of the Regional Administrative Radio Conference to Establish a Plan for the Broadcasting Service in the Band 1605-1705 kHz in Region 2 BC-R2(2), Rio de Janeiro, 1988.

[2] The 1990 agreement for the 1605-1705 kHz band is still in draft form because of the current "AM improvement" studies in Canada and the United States. However, an Interim Working Arrangement makes the draft agreement operational except for special consideration to be given for adjacent channel protection.

B-1.1 Requirements

B-1.1.1 This section describes the submissions that are required in support of applications for AM broadcasting stations operating with powers of 100 W or greater in the frequency band 525-1705 kHz. For powers of less than 100 W, refer to Section B-8.

B-1.1.2 Applications for a broadcasting certificate and for changes to an existing station shall be made on departmental Form IC-3050A, *Application for a Broadcasting Certificate for a Regular Power Undertaking.*

All necessary forms may be obtained from the departmental website at http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf06066.html.

When submitting an application to the Department electronically, the applicant shall use the following e-mail address: DBCE-APPS@ic.gc.ca.

The documentation to include is the following:

- the appropriate application form;

- the electronic brief (PDF format), including any required maps prepared in accordance with BPR-1;

- contours (MapInfo format: *.DAT/*.ID/*.MAP/*.TAB or GIS format: *.MIF,*.MID) (see section B-2.9); and

- form (in PDF format) IC-3052B entitled *Commitment Form.*

It is the responsibility of the applicant submitting the application to ensure that all electronic documents submitted have the necessary signatures.

The Department reserves the right to request a signed attestation to verify the authenticity of an application and may hold the processing of the application until a satisfactory attestation has been received.

When submitting an application on paper, the following documentation shall be included:

(a) two copies of the appropriate Form IC-3050A;

(b) one copy of an engineering brief in suitable loose-leaf binders with identifying labels. The brief shall be carefully prepared and include all the detailed technical information as outlined in Section B-2;

(c) completed forms listed in Annex 1, Parts I to V of the Canada/USA Agreement, 1984 (as part of the engineering brief only);

(d) one reproducible copy of each map showing the pertinent field strength contours (BPR-1, Section 3);

B-1.1.3 All proposed antenna structures whether new or modified, low or full power, must comply with the requirements of CPC-2-0-03 and Section 2 of BPR-1. In addition to meeting the requirements on site sharing, land-use consultation and public consultation, applicants must also fulfill other important obligations, including: compliance with Health Canada's Safety Code 6 guideline for the protection of the general public, compliance with radio frequency immunity criteria, notification of nearby broadcasting stations, environmental considerations and Transport Canada/NAV CANADA aeronautical safety responsibilities.

B-1.2 Definitions

B-1.2.1 AM Broadcasting Channel

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

B-1.2.2 Primary Service Area (525-1605 kHz)

Service area delimited by the contour within which the calculated level of the groundwave field strength is protected from objectionable interference in accordance with the provisions of Chapter 4 of Annex 2, Canada/USA Agreement, 1984.

B-1.2.3 Secondary Service Area (Applies to Class A Stations Only)

Service area delimited by the contour within which the calculated level of the field strength due to the skywave field strength 50% of the time is protected from objectionable interference in accordance with the provisions of Chapter 4 of Annex 2, Canada/USA Agreement, 1984.

B-1.2.4 Protected Contour

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

B-1.2.5 Allotment Area

Specifically defined geographical area within a country, to which one or more channels are allocated, as indicated in the Allotment Plan of Rio 1988 (Annex 4)[3].

B-1.2.6 Objectionable Interference

Interference caused by a signal exceeding the maximum permissible field strength within the protected contour or the allotment area.

[3] For protection criteria see Chapter 4 of Annex 2, Canada/USA Agreement, 1984.

B-1.2.7 Nominal Usable Field Strength (E_{nom})

Agreed minimum value of the field strength required to provide satisfactory reception, under specified conditions, in the presence of atmospheric noise, man-made noise and interference from other transmitters. E_{nom} has been employed as the reference for planning (see Annex 2, Chapter 4 of Canada/USA Agreement, 1984 and Annex 1, Chapter 3 of the draft Canada/USA Agreement, 1990).

B-1.2.8 Usable Field Strength (E_u)

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

B-1.2.9 Daytime Operation

Operation between the times of local sunrise and local sunset.

B-1.2.10 Nighttime Operation

Operation between the times of local sunset and local sunrise.

B-1.2.11 Groundwave

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

B-1.2.12 Skywave

Electromagnetic wave which has been reflected by the ionosphere.

B-1.3 Classification

B-1.3.1 Class A Station[4]

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

The maximum power of a Class A station shall be 50 kW.
The minimum power of a Class A station shall be 10 kW.

B-1.3.2 Class B Station[4]

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

The maximum power of a Class B station shall be 50 kW.
The minimum power of a Class B station shall be 250 W.

[4] For protection criteria see Chapter 4 of Annex 2, Canada/USA Agreement, 1984.

B-1.3.3 Class C Station[4]

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

The maximum power of a Class C station shall be 1 kW.
The minimum power of a Class C station shall be 100 W.

B-1.3.4 Low-Power Station

A low-power station is intended to provide coverage over a town or village and the immediate contiguous area. It is not protected against interference from Class A, B or C stations and shall take remedial action if it causes interference to such stations.

The power of a low-power station shall be less than 100 W.

B-1.3.5 Carrier Current Station

A carrier current station is intended to provide service within a given property, normally by feeding the RF signal into a power line or leaky cable. It is not protected against interference from Class A, B, C or low-power stations and shall take remedial action if it causes interference to such stations.

B-1.3.6 Stations in the 1605-1705 kHz Band

Classes are not designated for stations in this band, although the coverage is expected to be comparable to that of a Class C station.

The maximum power is 10 kW.

B-2. Outline of Sections and Details Required in Each Section of the Engineering Brief

The engineering brief should include the following list of sections and subsections with required details. The order should be maintained to facilitate processing by the Department.

B-2.1 Title Page

The title page should include submission title, project or reference number, date, name of applicant, name of consultant and location of station. It shall also list the following parameters of the proposal - frequency, power, class and mode of operation.

B-2.2 Table of Contents

B-2.3 Main Section of the Brief

B-2.3.1 **Introduction** - A general statement of the purpose for the brief in relation to the application.

B-2.3.2 Discussion

On the design considerations to accomplish the applicant's objectives, including the choice of frequency and location of site, with particular reference to interference limitations which may be received and caused by the proposed operation. Statements shall also be included with reference to the following:

(a) minimum field strength for metropolitan areas (in compliance with Section C-3);

(b) maximum field strength and broadcaster's responsibilities (in compliance with Section C-10);

(c) daytime rural service (a minimum of 0.5 mV/m to be provided);

(d) nighttime service (E_u).

B-2.3.3 **Assumptions and Sources of Information** - List and explain all assumptions which are made regarding conductivity, existing limitations, and combination of interference signals, etc. Also, list the sources of information, any equation not listed or referred to in the Canada/USA Agreement, 1984, maps, directional antenna patterns of other stations, etc.

B-2.3.4 **Groundwave Interference Analysis** - A general analysis and a summary of the detailed study to be made in a later section of the brief. The sample sheet of Appendix 1 shows the information required for the detailed study.

B-2.3.5 **Skywave Interference Analysis** - A general analysis and a summary of the detailed study to be made in a later section of the brief. The sample sheet of Appendix 2 shows the information required for the detailed study.

B-2.3.6 **Image Interference** - (Refer to Section C-9) - If it is not possible to meet the criteria of Section C-9, the following additional information is required in support of an exception:

(a) a justification for selection of the frequency proposed;

(b) a map showing the area of overlap of the pertinent contours of both stations;

(c) an estimate of the number of broadcast receivers within the area of overlap;

(d) a commitment that the applicant will investigate complaints of image interference and assume full financial responsibility for appropriate remedial measures.

B-2.3.7 **Intermodulation/Cross-modulation Interference** - (Refer to Section C-11) - Statements shall be included regarding the possibility of interference due to intermodulation/cross-modulation between broadcasting stations in the area and the remedial measures to be taken should such interference result.

B-2.3.8 **Other Significant Information** - Other technical information pertinent to the proposal should be included in this section. For example, there shall be a statement that the transmitter has been or will be type-approved. General comments should also be made respecting audio feed, rebroadcasting operations, etc.

B-2.3.9 **Qualification of Engineers** - This section shall contain a listing of names and signatures of those responsible for the preparation of engineering brief. It is important to note that one

signature at least, shall be that of an engineer with considerable experience in the AM broadcasting field, whose engineering stamp and signature should also appear in this section and on all coverage maps.

B-2.4 Description of Antenna System and Array

Forms listed in the Canada/USA Agreement, 1984, Annex 1, Parts I to V shall be completed as applicable. The format used is not important, but the data should be provided clearly and in the order shown in the Agreement to minimize the risk of data error. Additional information shall be given on the type of each element of the array (i.e. guyed or self-supporting, triangular or square, uniform cross-section or tapered, etc.).

B-2.5 Horizontal Field Strength Patterns

B-2.5.1 The methods to be used in calculating the directional antenna pattern, the expanded pattern and the modified pattern are detailed in Annex 2, Appendix 3, of the Canada/USA Agreement, 1984. The Annex 2 also includes criteria for reduced design tolerance. The plot of the horizontal field strength pattern for each power or pattern involved should show:

(a) the unattenuated directional field strength at one kilometre of the expanded or modified pattern as applicable and the equivalent unattenuated non-directional root-mean-square (r.m.s.) field strength of the theoretical pattern at one kilometre;

(b) the true north at zero azimuth;

(c) the direction to each existing station, with which interference may be involved.

B-2.5.2 Information concerning any variations from the normal practice, used in computing the above patterns shall be included such as:

(a) formulae used for calculating both horizontal and vertical patterns and sample calculations and their derivation;

(b) assumptions made (with justification), including electrical height, current distribution and efficiency of each element and ground conductivities.

B-2.5.3 The following guidelines shall be used in plotting field strength patterns:

(a) the expanded or modified patterns as defined in the Canada/USA Agreement, 1984, Annex 2, Appendix 3 shall be plotted on standard letter size polar coordinate paper with adequate margin;

(b) all patterns shall be plotted to the largest scale possible on the paper specified in (a);

(c) all values of field strength less than 10% of the r.m.s. field strength of the pattern shall be shown on an enlarged scale.

B-2.6 Plot Plan of Station Property Showing Location of Tower(s) and Ground System

Information is required as follows on one standard letter size sheet in the brief:

(a) a plot plan of suitable scale showing the location of the antenna tower(s) and the limits of ground system; also, the location of other nearby metallic structures (refer to BPR-1, Section 2.1);

(b) a map of scale 1:50 000 on which the antenna site is shown with the latitude and longitude of the centre of the antenna system to the nearest second (refer to BPR-1, Section 3.1.1).

If a site has not been selected at the time the application is made, a tentative site may be submitted to fill the requirements of this application procedure, with the understanding that applications for departmental approval of the final site, when selected, shall be made in a separate submission at a later date.

When the proposed site is submitted for approval, applicants are cautioned that an option should be obtained on the selected piece of property before submitting the information thereon to the Department.

B-2.7 Discussion of any Factors which Could Distort the Intended Antenna Patterns

If for any reason the calculated horizontal radiation pattern or characteristic vertical patterns are unlikely to be realized, unless extraordinary measures are taken, a detailed analysis of the abnormality shall be included in the engineering brief with a statement relative to any corrective measures which might be undertaken to attempt to achieve the intended shape of the pattern.

B-2.8 Interference Analyses

B-2.8.1 Groundwave Interference Analyses (Day and Night)

Groundwave interference analyses are to be prepared according to sample sheet of Appendix 1. Details such as protection rules, ground conductivity curves and methods of calculation may be found in Section C-2 and also in Annex 2, Chapter 2 of Canada/USA Agreement, 1984.

Analysis of nighttime interference to the groundwave service area from adjacent channel stations are to be prepared in accordance with Section C-5.

In groundwave analyses, where radiation in a particular sector is approaching the value required to protect another assignment, the clearance shall be confirmed over an arc. This necessitates a groundwave study on a number of bearings from the stations involved. For each of these cases, the protected points should be identified by geographical coordinates or in a separate map segment. On this map, the protected and interfering contours should be drawn to demonstrate the expected clearance.

Note: The Department will make available assignment information, including the location of protected field strength contours of Canadian stations from proofs of performance in departmental records.

B-2.8.2 Skywave Interference Analyses

Skywave interference analyses are to be prepared according to the sample sheet of Appendix 2. Details such as protection rules, skywave curves and method of calculating may be found in Annex 2, Chapter 4, of Canada/USA Agreement, 1984, for stations in the 535-1605 kHz band and in Annex 1, Chapter 2 of the draft Canada/USA Agreement, 1990 for stations in the 1605-1705 kHz band (also note Section C-4).

B-2.8.3 Calculation of Distance and Azimuth

All calculations of distance and azimuth are to be based on the short great-circle path assuming a spherical earth of radius 6370 km (one degree on the surface of the earth equals 111.18 km).

B-2.9 Maps Showing Pertinent Field Strength Contours

The following field strength contours shall be plotted for each radiation pattern proposed (i.e., if powers or patterns are different day and night), on up-to-date maps (refer to Section 3 of BPR-1):

1000, 250, 25, 15, 5, 0.5 mV/m, E_u and if within 0.5 mV/m contour, the contour which is 20% of E_u.

For stations in the 1605-1705 kHz band, the night E_u should be assumed to be E_{nom} unless the effect of existing or proposed stations would make it higher.

Maps are required for the following proposed service coverage contours:

(i) for daytime: one map showing the 25 mV/m, 15 mV/m, 5 mV/m and 0.5 mV/m contours;

(ii) for nighttime: one map showing the usable field strength (E_u) contour, and if enclosed within the E_u, the 25 mV/m and the 5 mV/m nighttime contour(s);

(iii) for daytime: one map showing the 1000 mV/m and 250mV/m contours.

Each map should be clearly labelled as to whether it applies to day or night operation.

For changes of facilities, a map shall be provided showing both the authorized and the proposed 0.5 mV/m and E_u contours.

If satisfactory precision cannot be obtained on a single map, separate maps should be used.

B-2.10 Additional Requirements

When the proposal involves the acceptance of objectionable interference as defined in both agreements, such areas shall be shown by cross-hatched areas on coverage maps.

B-2.11 Commitments

The commitments relating to the resolution of any potential interference problems as required in the above sections, shall be included:

(a) image interference (Section B-2.3.6 and Section C-9.2);

(b) intermodulation and cross-modulation (Section C-11.2);

(c) maintenance of reduced tolerance directional patterns (Section B-2.5.1 and Annex 2, Appendix 3, Attachment B of Canada/USA Agreement, 1984);

(d) any commitment which may have been made in reaching agreement with another station, particularly in relation to “lock-in” (Section C-8.2) and departures from normal protection requirements (Section C-12).

The above commitments are related to specific potential problems and complement the general commitment in the application forms.

B-3. Final Proof of Performance for Directional Antennas

An installation is deemed to be incomplete until the Final Proof of Performance of the directional antenna system has been submitted to the Director, Broadcast Applications Engineering, and approved by Industry Canada.

B-3.1 Documentation

When a station proposes to operate with a directional antenna either full- or part-time, it is necessary that proof be submitted that the pattern produced by the antenna array agrees with the pattern predicted and approved for that station, both as to shape and size within an acceptable tolerance. It is also necessary that proof be submitted as to the actual performance of the radiating elements, including impedance characteristics and radiation efficiency.

Field strength contours are required to show the actual coverage of the station, although the contour protected against interference from other stations is that calculated, in accordance with Annex 2, Chapter 2 of Canada/USA Agreement, 1984 and for stations in the 1605-1705 kHz band, with Section C-6, unless there is specific agreement between the stations involved.

The data outlined in Sections B-3.3, B-3.4 and B-3.5 shall be submitted in the proof of performance, together with a description of the procedure to be followed in obtaining these data.

B-3.2 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also, if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of Canada/USA Agreement, 1984. The upper limit may not be exceeded if interference would result.

B-3.3 Field Strength Measurements to Establish Effective Field Strength at One Kilometre

Beginning as near to the antenna as possible without including the induction field and to provide for the fact that a broadcast antenna is not a point source of radiation, measurements shall be made on eight or more radials, at intervals of approximately:

- 200 metres up to 3 kilometres from the antenna;
- one kilometre from 3 to 10 km from the antenna;
- and 3 kilometres beyond 10 km, as required.

Where unobstructed measurements can be made, there should be 18 or more on each radial. However, where unobstructed measurements are difficult to make, these shall be made on each radial at as many unobstructed locations as possible, even though the intervals are considerably less than stated above, particularly within five kilometres of the antenna. In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 8 or 10 kilometres due to the character of the intervening terrain), measurements at greater distances should be made at closer intervals.

The measurement data shall be plotted for each radial using log-log coordinate paper, with field strength as ordinate and distance as abscissa.

The proper curve to be drawn through the points plotted shall be determined by comparison with theoretical curves as follows:

- plot theoretical curves (refer to Appendix 2 to Annex 2 of the Canada/USA Agreement, 1984 and Annex 1, Chapter 2 of Rio 1988 Agreement) for several values of conductivities approximating the conductivity indicated by the measurements on another sheet of the same coordinate paper;

- place this sheet under the sheet on which the actual points have been plotted and adjust until the curve most closely matching the points is found;

- draw this curve on the sheet on which the points were plotted, together with the inverse distance curve corresponding to that curve.

The field at one kilometre for the radial concerned shall be the ordinate on the inverse distance curve at one kilometre.

When all radials have been analyzed in this manner, a curve shall be plotted on polar coordinate paper from the inverse distance field strengths obtained, which give the inverse distance field pattern at one kilometre. The radius of a circle, the area of which is equal to the area bounded by this pattern, is the effective field.

While making the field strength measurement, the output power of the station should be maintained at the licensed power as determined by the direct method. If a lower power is used, the results of the measurements should be adjusted appropriately. Therefore, it is necessary to determine the antenna impedances as accurately as practical and to measure the antenna current by means of an ammeter of known accuracy.

Complete data taken in conjunction with the field strength measurements shall be submitted, including the following:

(a) tabulation by number of each point of measurement, the field strength and the distance from the antenna;

(b) map(s) showing each point of measurement numbered to agree with the tabulation required in (a) above;

(c) curves drawn for each radial showing the field strength as a function of distance;

(d) antenna self impedances ($Z = R + jX$) for each tower measured at carrier frequency and in 10 kHz steps over the range ±30 kHz, and the results presented in tabular as well as graphical forms;

(e) antenna operating impedances ($Z = R + jX$) for each tower and for the day and/or night pattern at carrier frequency;

(f) antenna current or currents maintained during field strength measurements;

(g) any other pertinent information.

B-3.4 Field Strength Measurements to Establish Performance of Directional Antennas

To establish this performance, measurements shall be made in accordance with the preceding Section B-3.3 along a sufficient number of radials to establish the effective field from the antenna system. In the case of a relatively simple directional antenna pattern, approximately eight radials in addition to the radials in the directions of limitation are sufficient. However, when more complicated patterns are involved, that is, patterns having several sharp lobes or nulls, measurements shall be taken along as many additional radials as necessary to establish the pattern. It may be necessary to make ratio measurements, as described in Section B-4.1(a), to better define the pattern between radials.

The following information shall be submitted:

B-3.4.1 A description of the antenna array which shall outline:

(a) number of elements;

(b) type of each element (i.e., guyed or self-supporting, triangular or square, uniform cross-section or tapered, etc.);

(c) if top-loaded, pertinent details;

(d) overall height (in metres) of each element above ground level;

(e) orientation of each element with respect to true north from a reference point in the array;

(f) space phasing of elements (space phasing should be given in metres as well as in degrees);

(g) details of ground system for each element (length and number of radials, dimensions of ground screen if used, and depth buried);

(h) current in each element (at point where antenna ammeter is located) and current and impedance at point of common input to the antenna system;

(i) phase readings (specifying whether leading or lagging) and the relative current readings for each element.

B-3.4.2 Horizontal field strength patterns for each power involved showing:

(a) directional field strength at one kilometre and effective field strength from the antenna determined from the field strength calculations. These points should be shown on the expanded (or modified if applicable) pattern;

(b) true north shall be shown at zero azimuth.

B-3.4.3 Any other pertinent information.

B-3.4.4 Plotting of field strength patterns (refer to Section B-2.5.3).

B-3.4.5 Presentation of contour maps which shall include:

- the measured field strength contour maps in the same format as in Section B-2.9.

- the tabulation of all data used in plotting the above contours.

B-3.5 Test Equipment and Qualifications

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

(a) description, accuracy, date and by whom each instrument was last calibrated;

(b) name, stamp and signature of the engineer responsible for the measurements.

B-4. Preliminary Proof of Performance for Directional Antennas

It is recognized that the surveys and calculations necessary for a Final Proof of Performance may take considerable time. For this reason, the Department will normally accept a Preliminary Proof of Performance for the purpose only of permitting the station to commence operation, provided that the Final Proof of Performance is submitted within 90 days.

B-4.1 Documentation

The Preliminary Proof of Performance (in quadruplicate) shall be submitted to the Director, Broadcast Applications Engineering, at least five working days before commencement of regular broadcasting. It shall consist of:

(a) proof of the shape of the pattern determined from field strength measurements taken at a convenient[5] distance from the transmitter at approximately 15° intervals, by means of ratio between the directional pattern and non-directional operation, or by any other acceptable method such as short radials if a reliable non-directional pattern is not available;

(b) proof of the size of the pattern by means of a series of readings along one radial in a major lobe to a distance of at least 16 km. The approximate effective field at one kilometre, the attenuation curve and the mean conductivity for the region, shall be determined from these readings;

(c) antenna operating impedances ($Z = R + jX$) for each tower and pattern at carrier frequency and the antenna self-impedances for each tower measured at carrier frequency and in 10 kHz steps over the range of ±30 kHz.

Where protection to other stations on the same or adjacent channels is required, additional measurements shall be supplied to show that interference will not result from the operation of the station for which the proof of performance is being made.

[5] Close to the array, but beyond the nearfield.

B-4.2 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also, if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of Canada/USA Agreement, 1984. The upper limit may not be exceeded if interference would result.

B-5. Final Proof of Performance for Non-Directional Antennas

The installation is deemed to be incomplete until such time as the Final Proof of Performance of the antenna system has been submitted to the Director, Broadcast Applications Engineering, and approved by the Department.

B-5.1 Documentation (in quadruplicate)

A proof of performance demonstrating the inverse distance field strength in terms of millivolts per metre at a distance of one kilometre is required of all broadcasting stations operating with non-directional antennas.

Field strength contours are required to show the actual coverage of the station, although the contour protected against interference from other stations is that calculated in accordance with Annex 2, Chapter 2 of Canada/USA Agreement, 1984 and for stations in the 1605-1705 kHz band, with Section C-6, unless there is specific agreement between the stations involved.

The following are the data which shall be submitted in the proof of performance, together with a description of the procedure to be followed in obtaining these data.

B-5.2 Field Strength Measurements to Establish the Effective Field Strength at One Kilometre for Class A or B Stations

Beginning as near to the antenna as possible without including the induction field and to provide for the fact that a broadcast antenna is not a point source of radiation (not less than one wavelength or five times the vertical height), measurements shall be made on eight radials at intervals of approximately:

- 200 metres up to 3 kilometres from the antenna;
- one kilometre from 3 to 10 km from the antenna;
- and 3 kilometres beyond 10 km, as required.

Where unobstructed measurements can be made, there should be 18 or more on each radial. However, where unobstructed measurements are difficult to make, these shall be made on each radial at as many unobstructed locations as possible, even though the intervals are considerably less than stated above, particularly within five kilometres of the antenna. In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 8 or 10 km due to the character of the intervening terrain), the measurements at greater distances should be made at closer intervals.

The measurement data shall be plotted for each radial using log-log coordinate paper with field strength as ordinate and distance as abscissa.

The appropriate curve to be drawn through the points plotted shall be determined by comparison with theoretical curves as follows:

- plot theoretical curves (refer to Appendix 2, Annex 2 of the Canada/USA Agreement, 1984 and Annex 1, Chapter 2 of Rio 1988 Agreement) for several values of conductivities approximating the conductivity indicated by the measurements on another sheet of the same coordinate paper;

- place this sheet under the sheet on which the actual points have been plotted and adjust until the curve most closely matching the points is found;

- draw this curve on the sheet on which the points were plotted, together with the inverse distance curve corresponding to that curve.

The field at one kilometre for the radial concerned shall be the ordinate on the inverse distance curve at one kilometre.

When all radials have been analyzed in this manner, a curve shall be plotted on polar coordinate paper from the fields obtained, which gives the inverse distance field pattern at one kilometre. The radius of a circle, the area of which is equal to the area bounded by this pattern, is the measured effective field.

While making the field strength survey, the output power of the station should be maintained at the licensed power as determined by the direct method. If a lower power is used, the results of measurements should be adjusted appropriately. Therefore, it is necessary to determine the antenna impedance as accurately as practical, and to measure the antenna current by means of an ammeter of known accuracy.

Complete data taken in conjunction with the field strength measurements shall be submitted, including the following:

(a) tabulation by number of each point of measurement, the field strength and the distance from the antenna for each point of measurement;

(b) map(s) showing each point of measurement numbered to agree with the tabulation required in (a) above;

(c) curves drawn for each radial showing the field strength as a function of distance;

(d) antenna self impedance ($Z = R + jX$) at carrier frequency and in 10 kHz steps over the range ±30 kHz, and the results presented in tabular as well as graphical forms;

(e) antenna current (day and night) maintained during field strength measurements;

(f) any other pertinent information.

B-5.3 Field Strength Measurements to Establish the Effective Field Strength at One Kilometre for Class C Stations

The procedure for establishing the effective field strength at one kilometre for Class C stations or stations in the 1605-1705 kHz band, shall be the same as in Section B-5.2 above except that measurements may be made on two radials only, and need not extend beyond the 0.5 mV/m contour.

B-5.4 Test Equipment and Qualifications

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

(a) description, accuracy, date and by whom each instrument was last calibrated;

(b) name, stamp and signature of the engineer responsible for the measurements.

B-5.5 Plot of Field Strength

The measured field strength contours should be presented in the same format as in Section B-2.9.

B-6. Preliminary Proof of Performance for Non-Directional Antennas

The surveys and calculations necessary for a Final Proof of Performance may take considerable time. The Department will normally accept a Preliminary Proof of Performance for the purpose only of permitting the station to commence operation, provided that the Final Proof of Performance is submitted within 90 days.

B-6.1 Documentation

The Preliminary Proof of Performance shall be submitted to the Director, Broadcast Applications Engineering, at least three working days before commencement of regular broadcasting and shall consist of:

(a) a tabulation by number (at least 10) of each point of measurement of the field strength taken along one radial to establish with reasonable accuracy the inverse distance field strength in mV/m at one kilometre;

(b) distances from the antenna of all measurement points included in the tabulation required in (a) above;

(c) a plot of the measurements as required in Section B-5.2 with the unattenuated field at one kilometre indicated thereon.

Where protection to other stations on the same or adjacent channels is required, additional measurements shall be supplied to show that interference will not result from the operation of the station for which the proof of performance is being made.

B-7. Supplementary Proof of Performance

B-7.1 Introduction

Broadcasting stations at all times are required to protect other stations as prescribed by international agreements and domestic requirements. Therefore, it is imperative that the operation of broadcast transmitters and their antenna systems be checked from time to time. Accordingly, a supplementary proof of performance shall be submitted on request by the Department normally four years after submission of the previous supplementary or final proof. Supplementary proofs shall be submitted to the

office of the Department which requests them, normally the Engineering Branch of the appropriate regional office. Supplementary proofs of performance are not required for non-directional antenna systems.

In addition to normal monitoring, the following comprise the requirements for a Supplementary Proof of Performance to demonstrate that the broadcast antenna system continues to function as authorized.

B-7.2 Measurements

B-7.2.1 The shape of the directional pattern shall be determined from field strength measurements taken at a convenient distance from the transmitter at approximately 15 degree intervals by means of the ratio between the directional pattern and non-directional operation, or by any other acceptable method such as short radials if a reliable non-directional pattern is not available.

B-7.2.2 The size of the pattern shall be determined by means of a series of field strength measurements taken in a major lobe along one radial from approximately 200 metres from the antenna to a distance of 16 km or to the 0.5 mV/m contour whichever is closer. The effective field at one kilometre shall be determined from these readings as set forth in Section B-3.3.

B-7.2.3 Impedance characteristics of the radiating elements and the operating impedance at point of common input shall be determined by the direct method and expressed as $Z = R + jX$.

B-7.2.4 To determine the unattenuated field strength at one kilometre, the field strength measurement data should be plotted on log-log coordinate paper with field strength as ordinate and distance as abscissa. The appropriate curve to be drawn through the points plotted shall be determined by comparison with theoretical curves as follows:

- plot theoretical curves (refer to Appendix 2 of the Canada/USA Agreement, 1984 and Annex 1, Chapter 2 of Rio 1988 Agreement) for several values of conductivities approximating the conductivity indicated by the measurements on another sheet of the same coordinate paper;

- place this sheet under the sheet on which the actual data points have been plotted and adjust until the curve most nearly matching the points is found;

- draw this curve on the sheet on which the points were plotted.

The field at one kilometre for the radial shall be the ordinate on the inverse distance curve at one kilometre.

B-7.2.5 While making the field strength measurements, the output power of the station should be maintained at the licensed power as determined by the direct method. A careful log shall be taken of the operating parameters during the measurement period.

B-7.3 Documents

A Supplementary Proof of Performance shall comprise the following, prepared or approved by a professional engineer and submitted over the engineer’s stamp and signature:

(a) a statement of the work which was done, adjustments made, components replaced, measurements taken and instructions left with operating staff;

(b) a polar plot of the measured pattern and the expanded (or modified, if applicable) directional antenna pattern (see B-2.5.3 for guidelines);

(c) a plot of the field strength measurements made along the single radial, together with the inverse distance curve plotted on suitable log-log graph paper. The values of ground conductivity and field strength at one kilometre shall be marked;

(d) information on the antenna impedance measurements shall be provided showing:

(i) description of the methods employed;
(ii) measurement data;
(iii) impedances of each tower at the operating frequency expressed as $Z = R + jX$;

(e) a table of current and phase readings of the transmitter and antenna system as finally adjusted and the transmitter output efficiency;

(f) if other work was done at the transmitter, such as adjustment and calibration of supervisory control equipment, frequency or modulation monitors, proper documentation covering this work should also be included.

B-7.4 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of Canada/USA Agreement, 1984. The upper limit may not be exceeded if interference would result.

B-7.5 Test Equipment and Qualifications

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

(a) description, accuracy, date and by whom each instrument was last calibrated;

(b) name, stamp and signature of the engineer responsible for the measurements.

B-8. Applications for Low-Power Unprotected Stations and Carrier Current Systems with Transmitter Powers of less than 100 W

B-8.1 Low-Power Unprotected Broadcasting Stations

Normally, an application for a low-power unprotected broadcasting station is technically acceptable if:

(a) no interference to other stations is predicted, using regular protection criteria;

(b) the signal level within the area to be served is sufficient to provide reliable daytime and nighttime services;

(c) the disparity between day and night service is minor, i.e., the E_u contour shall enclose at least 90% of the population within the 0.5 mV/m contour.

The transmitter should meet Broadcasting Equipment Technical Standard No. 5 (BETS-5). The use of a transmitter which does not meet these standards could result in an inadequate quality of service.

B-8.1.1 Requirements for an Application

The requirements for an application for a low power broadcasting station are:

- one copy of Form IC-3051A as applicable;
- one copy of Form IC-3052B;
- one copy of an engineering brief.

Normally, an engineering brief need only describe the transmitting plant and location (population to be served, audio feed). However, if the Department's analysis indicates that protection or service requirements may not have been met, a detailed engineering submission may be requested.

With regard to locating the antenna site, please refer to Section B-1.1.3.

B-8.2 Carrier Current Systems

Normally, an application for carrier current system is considered technically acceptable if the technical requirements of the Department are met as set forth hereafter.

B-8.2.1 Requirements

(a) An engineering brief containing the following data shall be submitted to the Department:

- the location of the transmitter;
- the proposed frequency;
- the type of equipment to be used (manufacturer's name, model number, power). This equipment should be approved by Industry Canada.

(b) Such apparatus will deliver to the line network the minimum radio frequency power necessary to accomplish the desired purpose.

(c) No interference is expected to be caused to other radio services.

B-8.2.2 Proof of Performance and Certification Requirements

A proof of performance demonstrating that the installation meets the requirements mentioned below, shall be submitted to the Director, Broadcast Applications Engineering, at least five working days before the desired date for regular operation.

The applicant shall provide evidence that the electromagnetic field extending outside the property to be served containing the signal distribution circuit does not exceed 15 uV/m at a distance

$$d = \frac{48{,}000}{f}$$

d = the distance in metres
f = the frequency in kHz

from the property served. The measurements shall be taken in daylight using a field strength meter operated by an engineer or technician experienced in this work. The readings shall be obtained with the antenna not less than 50 cm nor more than three metres above ground at 12 points spaced as equally as may be practicable around the property at or within the required distance d.

If there are overhead power cables or other wires connected to the property, readings shall be obtained with the antenna directly under and in the same plane as the wires at the prescribed distance from the property.

Note: Theoretically, at 100% efficiency, the field from a fraction of a mW could exceed the 15 uV/m limit at the defined distance from the source.

The owner and operator of the system is responsible for ensuring that at the defined distance a possible interfering signal from the carrier current system does not exceed the maximum permissible field strength and does not cause interference to authorized radio services. In the event that interference is caused, the operator of the system shall promptly take steps to eliminate the interference and remedial measures would have to be taken to the extent of ceasing operation.

B-9. Applications Based on Deletion of Assignments in the Plan (535-1605 kHz Band)

B-9.1 Deletion or Transfer of an Unused Assignment

B-9.1.1 As a number of the unused Canadian assignments in the Plan were based on an estimate of a need in a general area, such assignments may be transferred to an alternate community if the necessary protection criteria are met. The brief shall include a discussion of the assignments available in both communities.

B-9.1.2 If an application is based on the deletion of an unused assignment, other than a transfer, the applicant shall provide a detailed analysis demonstrating the unavailability of a satisfactory alternative; and

(a) demonstrate that adequate alternate assignments are available in the Plan; or
(b) propose modifications to the Plan to replace the deleted assignment.

B-10. On-Air Testing Procedure

When the construction of the authorized facilities is complete, notice of on-air testing shall be given to the District Manager at least three weeks (unless otherwise specified in the letter of authority) prior to transmission tests. Departmental permission from the District Office is required for testing.

During on-air tests, identification of the station shall be made, preferably at 15-minute intervals, giving as a minimum the call sign, frequency and location of the station. In the case of rebroadcasting stations without capability to originate the aforementioned information, the broadcaster will be responsible for making the public aware that the new station is being tested. As an example, a notice could be placed in the local press which would explain that the broadcaster should be contacted in the event of interference difficulties that might develop. The broadcaster shall implement any instruction given by departmental representatives at the district, regional or headquarters level.

The required scope and duration of such on-air emission tests will depend to a large extent on the potential for interference that might be caused to existing broadcasting stations or other radio services. Such details of the testing shall be agreed upon with the local District Manager soon after the issuance of the letter of authority.

Following successful on-air tests, the applicant's consultant shall certify to the Department that the station is ready to commence operation in accordance with the approved technical submission and request permission to commence normal broadcasting schedule.

Section C: Technical Requirements for AM Broadcasting Stations in the 525-1705 kHz Band

This section establishes the technical requirements to be followed in designing of AM broadcasting stations operating with powers of 100 W or greater in the frequency band 525-1705 kHz.

C-1. Antennas and Ground Systems

The design of an antenna system for a station shall conform to the following requirements:

(a) vertical radiators shall be used under most circumstances; use of other types of radiators requires special case consideration;

(b) the height of vertical radiators should be at least 1/6 wavelength or equivalent, but not exceed 5/8 wavelength;

(c) top-loading of vertical radiators is sometimes used to increase the effective height. However, this should be avoided whenever possible, since it affects the vertical radiation characteristics. If used, top-loading shall be symmetrical and not exceed 1/8 wavelength equivalent height. When top-loading is achieved by physical additions to the radiator (rather than using the guy wires), such additions shall be taken into consideration in assessing the structural adequacy;

(d) structural adequacy requirements are in BPR-1, Section 2;

(e) all antenna towers shall be painted and lighted in accordance with Transport Canada's requirements;

(f) all antenna towers, transmission lines, etc., on which dangerous radio frequency voltages and currents exist, shall be located and protected to preclude the possibility of accidental contact;

(g) ground systems shall consist of at least 120 radial wires evenly spaced and radiating out from the base of the radiating element unless the design of the antenna system is such as to require other configurations. Radial wires shall not be smaller than no. 10 B & S gauge, and should normally be buried no deeper than 20 cm in the ground for a distance not less than 0.25 wavelength from the antenna;

(h) in selecting the site, every consideration should be given to the conductivity of the ground at the site and the complications which may arise in laying the ground systems specified under this technical requirement. To minimize deformities in the radiation pattern, the difference in antenna base elevation of each tower shall not exceed 10% of the physical height of the shortest tower used in the array.

C-2. Ground Conductivities

C-2.1 The official ground conductivity values for Canada are contained in the issue of Industry Canada's map entitled *Ground Conductivity Map for MF Broadcasting Band* dated January 1980.

The map consists of five separate sheets labelled Atlantic Provinces, Quebec, Ontario, Prairie Provinces and British Columbia. Individual sheets (or a complete set) are available from the Radiocommunications and Broadcasting Regulatory Branch, Industry Canada, 300 Slater Street, Ottawa, Ontario, K1A 0C8.

C-2.2 An appropriate map for northern regions based on limited measured field strength data, geological composition and data from measurements in adjacent bands was prepared in 1985 and is available on request.

C-2.3 The official ground conductivity values for the United States are contained in the Federal Communications Commission's map Figure M3 entitled *Estimated Effective Ground Conductivity in the United States.*

C-2.4 For the above maps, the international border is considered as a conductivity boundary.

C-2.5 Conductivity values from the maps shall be used for all coverage and interference calculations, unless the applicant provides a suitable showing in accordance with Sections C-2.6 and C-2.7 to use other values.

C-2.6 Conductivity values other than map values will be considered in cases involving calculated interference to existing broadcasting services, if it can be demonstrated, as a result of extensive measurements, that interference is unlikely to occur in practice. Normally, measurements shall be made from the proposed antenna site, using a test transmitter if necessary. The location of the protected contour shall normally be calculated using conductivity values from the map or from some other mutually agreed sources. If agreed by both parties, the location of the protected contour may be derived from the Final Proof of Performance of the affected station.

C-2.6.1 An applicant proposing the use of conductivity values other than map values shall provide the affected station with one copy of the engineering brief or the appropriate parts thereof at the time of filing the application with Industry Canada.

C-2.6.2 The affected station shall, upon receiving a copy of the engineering brief proposing the use of conductivities other than map values, either accept or object to the values used. The affected broadcaster shall advise the Department and the applicant in writing within 30 days from the receipt of the engineering brief that an objection may be made to the ground conductivity values used by the applicant, as soon as ongoing studies are completed. Failure to respond within the given time limit implies acceptance of the values used.

C-2.6.3 In the event that the affected station objects to the use of the conductivities involved in the engineering brief, the station shall be invited to participate in a measurement program approved by Industry Canada, during which the two parties should reach an agreement as to the acceptable conductivity and thus the allowable radiation to provide protection to the affected station. The measurement program should be undertaken at the mutual consent of both parties. In some cases, it may be necessary to repeat the measurements at a different time of year to take seasonal variation of conductivity into account. If agreement cannot be reached, the Department will assess the application on the basis of the submissions by both parties and its own studies.

C-2.6.4 If an application is approved on the basis of other than map conductivity values, whether or not agreement has been reached with the affected station, and if it can be shown that interference occurs in practice, the interfering station shall immediately reduce the radiation towards the affected station. The values of the reduced radiation will be determined by calculations based on map conductivity values or intermediate values mutually agreed upon by both parties. If the appropriate reduction of radiation cannot be made within seven days by adjustment of a directional pattern, it shall be made by reduction of power.

C-2.7 Until a better method is developed to allow for seasonal variation, measurements will have to be repeated under conditions representative of at least two extremes, unless there is agreement from the affected broadcaster.

C-3. Minimum Field Strength Requirements for Satisfactory Service to Metropolitan Areas

C-3.1 Requirements

In the selection of a transmitter site for an AM broadcasting transmitting station, the objectives are to provide adequate service to a centre of population usually referred to as a metropolitan area[6] (in which the studio is normally located), and to give maximum coverage to adjacent areas with a minimum of interference to and from other users of the radio spectrum. Although a minimum intensity of 25 mV/m is desirable to provide a broadcast service to the business and/or factory areas of a city, a minimum field intensity of 5 mV/m is normally required for a residential area.

C-3.2 Selection of Site

The power, antenna characteristics and location of an AM broadcast transmitting system shall be selected in compliance with the following:

(a) the 5 mV/m contour and the usable field strength (E_u) nighttime contour, if it exceeds 5 mV/m, shall enclose the metropolitan area;

(b) for proposals in which it is demonstrated that the requirement of C-3.2(a) cannot be met with respect to the E_u contour, that contour shall enclose at least 50% of the metropolitan area;

[6] A metropolitan area is considered to be any area where there are located in reasonably continuous fashion, industrial or residential buildings on parcels of ground normally referred to as building lots.

(c) proposals for accepting E_us greater than 25 mV/m shall be supported by sufficient data to justify consideration as a special case.

C-4. Skywave Protection Requirements

C-4.1 Chapter 4 of the Final Acts of the RAMFBS-R2 prescribes the protected contours for Classes A, B and C stations and the methods to be used in calculating the skywave interference to skywave and groundwave service contours. The Canada/USA Agreement, 1984, prescribes the same methods in Annex 2, Chapter 4.

C-4.2 It should be noted that when protecting assignments in Greenland, Saint-Pierre-et-Miquelon, Mexico and the United States, the value of all interfering skywave signals to any of these countries is determined using the 10% skywave curves as defined in paragraph 3.4 of the RAMFBS-R2. When protection to all other countries is determined, 50% skywave curves are to be used for all calculations of skywave interfering signals.

C-4.3 In certain instances where skywave interference to groundwave service is being considered, if adequate margin of protection is allowed, and if the protected station is at a considerable distance from the new assignment, it is probable that skywave protection of the transmitter site would automatically provide acceptable protection to the nighttime groundwave service contour. Otherwise, protection shall be provided to the actual service contour. Technical submissions, predicated upon transmitter site protection only without due consideration being given to possible interference occurring within the nighttime groundwave service contour, will be considered to be technically in error and returned for correction.

C-4.4 The E_u, and all interference levels shall be calculated using expanded (or modified, if applicable) patterns.

Stations in the 1605-1705 kHz band are required to protect co-channel allotment areas from skywave interference as specified in Annex 4 of the draft Canada/USA Agreement, 1990 for Canada and the United States and in Annex 1, Chapter 2 of Rio 1988 Agreement for other countries, e.g. Greenland and Saint-Pierre-et-Miquelon.

C-5. Nighttime Protection of the Groundwave Service Area of all Stations against Interference from Adjacent Channel Stations (525-1605 kHz Band)

C-5.1 Protection

C-5.1.1 Chapter 4 of both the RAMFBS-R2 and the Canada/USA Agreement, 1984, requires adjacent channel groundwave protection of the nighttime service area to the 0.5 mV/m contour. Because of the present congestion in the AM band, and since it is not considered necessary to offer a greater degree of protection from interference by adjacent channel stations than that from co-channel stations, a relaxed rule has been adopted for domestic use only. This rule relaxes the nighttime protection criteria of the adjacent channel where appropriate, taking into consideration the co-channel interference.

C-5.2 Nighttime Protected Contour

C-5.2.1 For the purpose of calculating the allowable interference signal from an adjacent channel, the nighttime protected groundwave contour is determined as follows:

(a) for Class A stations, the nighttime protected groundwave contour is the 0.5 mV/m contour;

(b) for Class B and Class C stations the nighttime protected groundwave contour of all domestic stations is the 0.5 mV/m contour or the contour corresponding to 20% of the E_u, whichever encloses the smaller area.

C-5.3 Permissible Interference Level

C-5.3.1 The maximum level of interfering groundwave signal on the nighttime protected groundwave contour of a station is as follows:

Frequency separation between stations	Maximum level of interfering groundwave signal
10 kHz	0.5 mV/m
20 kHz	15.0 mV/m

C-6. Groundwave and Skywave Protection Requirements (1605-1705 kHz Band)

C-6.1 Protection Between Canadian Stations

In general, the protection criteria between assignments in the 535-1605 kHz band apply.

C-6.1.1 The daytime 0.5 mV/m contour is protected from groundwave interference using the relevant co-channel, first adjacent channel or second adjacent channel protection ratio.

C-6.1.2 The nighttime E_u or E_{nom} (whichever is the higher value) contour is protected from skywave interference.

C-6.1.3 The nighttime 20% E_u or E_{nom} (whichever is the higher value) contour is protected from adjacent channel groundwave interference as in C-5.

C-6.1.4 The 25 mV/m contours of third adjacent channels shall not overlap.

C-6.2 Protection to Foreign Allotments

C-6.2.1 Stations in the 1605-1705 kHz band are required to protect the entire allotment areas in other countries from co-channel skywave and groundwave interference and from second adjacent channel groundwave interference.

C-6.2.2 Protection requirements to first adjacent channel allotments from proposed stations on Canadian allotments are found in the Rio 1988 Agreement. Since all allotments along the Canada/United States border are adjacent channel and there was a need to allow for different rates of usage, the Agreement provides guaranteed access and full protection to priority allotments, and equal access to other allotments. While the draft Canada/USA Agreement, 1990 contains the same technical criteria for first adjacent channel protection, the Interim Working Arrangement allows for the application of more stringent criteria (unspecified) due to ongoing "AM improvement" studies in both countries.

C-7. Protection between the 535-1605 and 1605-1705 kHz Bands

C-7.1 In general, the draft Canada/USA Agreement, 1990 requires that assignments in the 535-1605 kHz band and allotments in the 1605-1705 kHz band be protected as if the proposed station were in the same band as the protected assignment or allotment.

C-7.2 The same provision will apply for protection between Canadian stations, but Canadian allotments on 1610-1630 kHz do not have to be taken into consideration by Canadian proposals on 1580-1600 kHz, since that would completely block any further use of the latter channels.

C-8. "Lock-In" of the Groundwave Service Area of Second Adjacent Channel Stations

C-8.1 Protection of the Groundwave Service Area of Second Adjacent Channel Stations

C-8.1.1 The criteria for the second adjacent channel protection of the groundwave service is outlined in Chapter 4 of the RAMFBS-R2 and the Canada/USA Agreements, 1984 and Rio 1988 Agreement. For broadcasting stations with a second adjacent channel relationship, the required ratio of desired groundwave signal to interfering groundwave signal is 1:30 (-29.5 dB). Therefore, the allowable interfering signal to protect the 0.5 mV/m contour of a station is 15 mV/m. Past experience has shown that applying this criterion will result in mutual protection for the service areas of the two stations. However, depending upon certain factors such as the power of a proposed station or local ground conductivity, it is possible for the 15 mV/m contour of an existing station to be intersected or completely encircled by the 0.5 mV/m contour of a proposed station. Because the 0.5 mV/m contour becomes the protected contour, the existing station becomes "locked-in" and is seriously inhibited or prevented from changing its facilities unless the station changes frequency (which is not always possible) or an understanding can be arrived at between the two stations. The purpose of this rule is to permit the "locked-in" station to change its facilities on its present frequency, as long as other application requirements are met.

C-8.2 Application Process

The following are the steps to be taken in the process when an application is submitted for a proposed station or a change in facilities of an existing station and the 0.5 mV/m contour of the proposal intersects or encircles the 15 mV/m contour of another station separated by 20 kHz.

(a) The applicant shall send a copy of the engineering brief and a covering letter, by registered mail, to the licensee of the station affected no later than the date of filing an application. A copy of the letter shall also be sent to Industry Canada.

(b) Where an agreement protecting the right of the "locked-in" station to make future changes of facilities has been reached between the involved parties prior to filing the application, copies of the agreement shall be submitted with the engineering brief as part of the application for a broadcasting certificate. The application is then processed by the Department in the normal manner, but the technical evaluation would include an assessment of the constraints involved and the acceptability of the agreement.

Or

(c) Where no agreement has been reached between the parties prior to filing the application, Industry Canada would process the application as in (b) above but in referring the application to the CRTC, the Department would provide an assessment of the constraints involved and would advise that the affected station is aware of the situation. In cases where no agreement has been reached, the Department may impose conditions which would protect the rights of the "locked-in" station.

C-9. Image Interference

C-9.1 Introduction

When two transmitting stations in the same area operate on frequencies which differ by a value equal to twice the intermediate frequency (IF) of broadcast receivers, image interference may occur to the reception of the station on the lower frequency. Since the nominal IF of receivers used in Canada is 455 kHz with a standard deviation of 4 kHz, interference may be caused to the reception of any station in the range 530 to 800 kHz by a station whose frequency is 900 to 920 kHz higher, that is, in the range 1430 to 1700 kHz. The interference level has been found to be objectionable to a significant proportion of broadcast receivers where the field strength ratio of the high frequency to the low frequency station signals is greater than 30:1. Although the interference can be remedied sometimes by the adjustment of receiver IFs, this has been found to be impractical. Therefore, to avoid objectionable image interference situations, there should be no overlap of the 0.5 mV/m contour of the station on the lower frequency by the 15 mV/m contour of the station on the higher frequency.

C-9.2 Proposals Predicated on Image Relationship

Due to the congestion of stations in some areas, it may not be possible to avoid an image relationship in the selection of a frequency. The Department would be prepared to consider a proposal predicated on an image relationship provided that the area where the 30:1 field strength ratio is exceeded is small and sparsely populated so that the receivers affected would be few in number and an effective program of adjustment of receiver intermediate frequencies could be successfully carried out. The burden of technical and financial responsibility lies with the applicant of the incoming station having the most recent notification date. This applies to a new station or an existing station applying for a change in facilities, except as follows:

(a) where a 900 kHz frequency separation already exists between stations;

(b) where the station on the lower frequency accepted an area where the 30:1 field strength ratio was exceeded at the time of notification of its present operation.

In the latter cases, the responsibility of the station on the higher frequency is limited to receivers within the 250 mV/m contour under the general commitment in the application form.

C-10. Assessment and Control of Maximum Field Strength of AM Broadcasting Stations

C-10.1 Introduction

Service requirements and constraints related to the siting of AM broadcasting stations may result in high signal strength levels in populated areas. Under these conditions, AM receivers are susceptible to intermodulation interference. Also, broadcast receivers are susceptible to immunity-type interference, and non-radio frequency equipment (radio-sensitive equipment) may be affected as well.

To avoid or to minimize such problems, applicants are encouraged to locate their transmitters away from populated areas. Where this is unavoidable, it is necessary to assess the potential for interference.

C-10.2 Purpose

The purpose of this subsection is to:

- identify the analysis required from applicants in determining interference potential,
- define the responsibilities of the broadcasters in response to interference complaints,
- identify non-valid complaints of interference.

The requirements of this section apply to all applications for the issue or amendment of broadcasting certificates for class A, B or C AM broadcasting stations.

C-10.3 Requirements for Interference Analyses and Population Estimates

In addition to the departmental requirements contained in Section B-2 pertaining to the engineering brief, interference analyses as per Section C-10.3.1 are required. In specific cases, the Department may accept a common assessment for co-located stations, multiplexed or otherwise.

C-10.3.1 Protection of AM Receivers Against Intermodulation and Cross-modulation

Applicants and existing broadcasters are to ensure that their installations are designed and operated in consideration of the following requirements in order to better assess the potential for interference:

Demonstrate that the transmitting site, the antenna pattern and the power of the station is in compliance with the following:

(a) the population within the day or night 250 mV/m contour shall not exceed one person per watt of transmitter power. For example, for 10,000 watts, the population should not exceed 10,000 persons;

(b) the population enclosed by the day or night 250 mV/m contour shall not exceed one third of the total population within the centre to be served; and

(c) the population within the day or night 1 V/m contour should be less than 0.02% of the population within the 5 mV/m contour.

C-10.3.2 Special Cases

In special cases, the Department may give consideration to a new station or changes to an existing station if the population limits listed in C-10.3.1 are exceeded, particularly when the limits are already surpassed by the existing population. In such cases, the applicant shall:

(a) submit a study, prepared by a broadcast consultant, to show possible receiver-generated intermodulation and cross-modulation products that coincide with the frequencies of other radio services received within the station's 1 V/m and 250 mV/m contours;

(b) undertake to reduce the power of the station to a level stipulated by the Department if there is a substantial number of complaints which cannot be resolved satisfactorily; and

(c) provide recent aerial photographs showing pertinent residential and industrial sites in the area.

An applicant proposing changes to the facilities of an existing station shall submit a commitment to revert to the previous facilities in the event of interference developing.

C-10.4 Resolving Issues

C-10.4.1 Responsibilities

The broadcaster will accept responsibility to:

(A) In the case of intermodulation or cross-modulation type interference

- remedy *valid* complaints of interference caused by the station to radio frequency devices within the 250 mV/m contour (refer to Section C-10.5 for list of complaints judged *not valid* by the Department), and

- provide technical advice to complainants, located between the 250 mV/m contour and the service contours of the station, concerning appropriate action to resolve interference problems attributed to the station, and
- provide technical advice to complainants to resolve interference problems concerning receivers in motor vehicles in cases where:

  (a) the interference is to a previously received local station which is separated by ±40 kHz or less from the incoming station; and

  (b) the interference occurs on a route regularly travelled (at least twice weekly) by the complainant and of which at least 1 km is enclosed by the 1 V/m contour;

    - keep the appropriate district office of the Department fully informed of all complaints received and action taken.

(B) In the case of immunity-type interference

The broadcasters will be responsible of solving immunity-type interference when applicable, i.e. for valid complaints.

The guidelines on resolving immunity issues related to radio-sensitive equipment are outlined in Industry Canada's Client Procedures Circular, *Determinations of Harmful Interference with respect to Radio-Sensitive Equipment* (CPC-3-14-01). This CPC can also be used as a guide for resolving immunity-related interference to broadcast receivers and associated equipment.

C-10.5 List of Complaints Judged Not Valid by Industry Canada

The following list identifies the types of complaints judged *not valid* by the Department and for which the broadcaster is not responsible for remedial action:

(a) where the complaint is attributed to the use of a malfunctioning or mis-tuned receiver or an improperly installed or defective antenna system;

(b) where the complaint is attributed to the desired signal being received at a location outside of the coverage area of the station;

(c) where the complaint is attributed to the desired signal not being favourably received because of adverse local propagation conditions or building penetration losses;

(d) where the complaint involves the reception of signals originating from outside of Canada;

(e) where the complaint involves the malfunction of radio frequency devices that are located inside the 250 mV/m contour, if the devices were introduced within the contour *after* the station started operating with the new facilities;

(f) where the complaint involves a high gain receiving antenna and/or an antenna booster amplifier intended for reception of distant stations which, as a consequence, overloads the receiver or creates intermodulation in the amplifier output;

(g) where the complaint involves intermodulation or cross-modulation interference to AM receivers or radio frequency devices that are located inside the 250 mV/m contour, if the devices were introduced within the contour *after* the station started operating with the new facilities;

(h) where the complaint is attributed to immunity-type interference in broadcast receivers/associated equipment or in radio-sensitive equipment that are located in areas where the measured field strength does not exceed 1.83 V/m or 3.16 V/m respectively;

(i) any other complaint which, in the judgement of the Department, is considered *not valid*.

C-11. Special Consideration Concerning Intermodulation and Cross-Modulation Interference

C-11.1 When transmitting stations operate in close proximity to each other, there is a possibility of interference resulting from intermodulation and/or cross-modulation at transmitting installations. In selecting a site for a station, every precaution should be taken to avoid

locating any transmitter within the 250 mV/m contours of another transmitter. Although it is possible to design installations to tolerate high field strengths from nearby stations, in practice, these would become special cases.

C-11.2 When the 250 mV/m contour of a proposed station or change in facilities of an existing station encloses the transmitting site of another station, the Department requires that the applicant's broadcast engineering consultant study the situation, considering potential interference and distortion of the antenna pattern of the other station. If found necessary, suitable filters would be installed at all stations involved to reduce the interference or distortion to an acceptable level. The applicant will bear all expenses, including those due to a loss of revenue resulting from a station having to suspend operation while remedial action is being taken.

C-12. Departures from International Agreements for Domestic Use in Canada

In certain proposals for broadcasting stations, the design of the transmitting facilities is in accordance with the underlying principles of the RAMFBS-R2, the Rio 1988 Agreement and the Canada/USA Agreements, but, under a strict interpretation of the procedures and rules, it depends upon a departure from the accepted criteria. An example is the case of a protected service contour extending over a body of water, or outlying terrain with no resident population, where the presence of an interfering signal greater than the specified limit would not be detrimental to service. Protection of such areas may require high cost complex installations and, where that may not be feasible, a loss of usable spectrum or coverage for Canadian stations may result.

Therefore, the Department would be prepared to consider such proposals but only where protection to Canadian stations is involved and provided that the engineering brief presents adequate justification, including the following:

(a) a detailed analysis demonstrating the unavailability of satisfactory alternative;

(b) a documentary evidence as to the extent of resident population within the area of proposed interference;

(c) a list of stations normally received in the affected area;

(d) a detailed analysis concerning the departure from the limiting boundary conditions;

(e) a statement from the licensee of any station affected agreeing to the interfering condition as described under (b) above.

However, the departure from recognized technical requirements, and its effect on existing stations, would have to be examined most carefully to determine whether the application would be acceptable for processing.

Appendix 1 - Sample Sheet

GROUNDWAVE INTERFERENCE ANALYSIS FOR XXXA, CITY 1, PROVINCE, POWER: 5 kW, FREQ.: 1000 kHz, CLASS B

PROTECTED STATIONS					PROTECTED STATION TO PROTECTED POINT						INTERFERING STATION TO PROTECTED POINT					
CALL	FREQ. (kHz)	CL.	PWR (kW)	LOC.	PT.	CONT mV/m	RADN mV/m	BRG deg	DIST km	PATH ANALYSIS	RADN mV/m	BRG deg	DIST km	PATH ANALYSIS (Cond./dist.)	PERM SIG mV/m	INT SIG mV/m
XXXB	1000	B	1	City 2, Prov, State	A	0.5	391	71.5	136.7	8/136.7	738.5	230	391	6/128.7 2/16.5 10/22.5 8/77	.025	0.174
					B	0.5	379.7	52.5	135.1	8/135.1	782.1	236.5	381.3	6/143 2/149.6 10/16.1 8/77	.025	0.176
					C	0.5	373.3	45	134.3	8/134.3	723.9	239	381.3	6/146.4 2/151 10/27.3 8/72.4	.025	0.0208
					D	0.5	368.5	38.5	133.5	8/133.5	727.3	241.5	389.4	6/154 2/112.6 10/49.9 8/72.4	.025	0.0221
					E	0.5	362	30	131.9	8/131.9	728.9	243.5	399	8/153 2/115.8 10/54.7 8/75.6	.025	0.0149
XXXC	1000	B	10	City 8, Prov, State	A	0.5	1568.8	14.5	232	15/29 10/203	748.2	165	358.8	6/75.6 2/278.3 10/4.8	.025	0.0163
					B	0.5	1562.8	5.5	230	15/32 10/198	764.3	172.5	354	6/77.2 2/197.9 10/77.2	.025	0.0204
					C	0.5	1383.7	353.3	220	15/32 10/188	778.7	181	358.8	6/48.3 2/181.8 10/53 4/11.3	.025	0.0213
					D	0.5	1142.4	343	206	15/37 10/169	785.2	187.5	360.4	6/53.1 2/173.8 10/175.4	.025	0.0224
					E	0.5	828.6	328	186	15/37 10/149	788.4	191.5	436	6/53.1 1/172.2 10/175.4	.025	0.0122

Appendix 2 - Sample Sheet

SKYWAVE INTERFERENCE ANALYSIS FOR XXXA, CITY 1, PROVINCE															
PROTECTED STATIONS				**INTERFERING STATION**								INTERFERENCE (mV/m)			
CALL	**CL**	**PWR (kW)**	**LOCATION**	**CALL**	**CL**	**PWR (kW)**	**LOCATION**	**DIST (km)**	**BRG (deg)**	**Θ (deg)**	**RADN (mV/m)**	**INT (10%)**	**E_u**	**PROP RADN**	**PROP INT**
XXXX	B	2.5	City 2, Prov/State	XXXB	B	1	City 2, Prov/State	878.5	304.5	10.4	342.7	4.9			
				XXXC	B	5	City 3, Prov/State	1227.7	104.5	6.1	555.1	4.55			
				XXXD	B	1	City 4, Prov/State	1755.4	328	2.3	307.3	0.96			
				XXXE	B	5	City 5, Prov/State	1108.6	354	7.3	1312.9	13.2*	13.2		
				XXXF	B	50	City 6, Prov/State	2429.6	48	0	2558.3	3.21			
				XXXA	B	10	City 1, Prov	1166.5	282.5	7.0	489.9	4.48		371.8	3.4
XXX1	B	50	City 13, Prov/State	XXXB	B	1	City 2, Prov/State	1327.6	101	5.3	90.1	0.626			
				XXXC	B	1	City 8, Prov/State	810.9	89.5	16.1	18.5	0.288			
				XXXH	B	.5	City 9, Prov/State	381.3	83	25.9	52.6	1.484*	2.43		
				XXXI	B	50	City 10, Prov/State	978.3	39	8.9	156.7	1.918*			
				XXXJ	B	1	City 11, Prov/State	1255	56	6.0	104.1	0.79			
				XXXA	B	10	City 1, Prov	1041	127	8.0	16.1	0.18		93.3	1.044

N.B. For the 1605-1705 kHz band skywave, studies are based on protecting allotment areas.

* Contributor to the calculated value of E_u